Anticipated Levels of Activity

Part of Alternative B would involve identifying projects (mechanical and prescribed fire) with the objective to reduce hazardous fuels near interface areas as well as other projects with the objective to reduce hazardous fuels.

Comparing the anticipated levels of activities for the two alternatives provides a basis for impact analysis and better shows the anticipated differences between the two alternatives. Table 3 displays the comparison of anticipated levels of activities between the two alternatives.

TABLE 3 COMPARISON OF ANTICIPATED AVERAGE ANNUAL LEVEL OF ACTIVITY

ACTION/TREATMENT	ALTERNATIVE A	ALTERNATIVE B
Wildland fires (average number and BLM acres burned)	77 fires; 9,068 acres. Number, damage, and cost of suppression would increase.	Similar to A in the short term; acres burned and intensity of fires would gradually decrease as hazardous fuel loads are reduced. Damage and cost of suppression should decrease in areas treated.
Acres of rehabilitation	unknown, but related to the number of acres burned by wildfire	Same as A in the short term; eventually the number of acres treated should be less than with Alternative A since wildfire on treated areas should require less rehabilitation.
Prescribed fires (annual average number and acres treated)	10 fires; 2200 acres. Some RMPs limit the acres treated with prescribed fires.	The number and total acres treated would increase. Acreage limitations on the use of prescribed fire would be removed.
Projects with the objective to reduce fuels near interface areas	0	The number of projects and acres treated would increase dramatically. 91 priority interface areas with hazardous fuels were identified in FY 2001.
Projects with an objective to reduce hazardous fuels	0	The number of projects and acres treated would increase dramatically.
Projects to meet other resource objective.	0	The number of projects and acres treated would increase.

AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

This section describes the resources and values that could be affected by fire management decisions on public lands. Also summarized in this section are the environmental consequences that are anticipated to occur as a result of fire (both wildland and prescribed fire). A summary description of the land and vegetation types and fire effects on these vegetation types is compiled from detailed information about fire effects on specific vegetation types. The environmental effects of prescribed burning and other vegetation treatments on other resources and values are summarized from the 1991 Final Environmental Impact Statement on Vegetation Treatment on BLM Lands (USDI, BLM).

Critical Elements of the Human Environment

The following elements of the human environment are subject to requirements specified in statute, regulations, or executive order. Past management plans (Alternative A) have not always considered critical elements when developing fire management objectives or guidance relative to wildland fire suppression or rehabilitation or for prescribed burning.

The proposed fire management plan (Alternative B) does consider the following critical elements in developing fire management objectives and guidance for wildland fire suppression and rehabilitation as well as guidance for prescribed fire and other hazardous fuels reduction efforts.

Air Quality: Any decisions or actions related to prescribed burning and other fuel reductions projects must comply with air quality legislation, including the Clean Air Act. The impacts are described in the air quality section. Further resource considerations (Appendix A) contain guidance related to air quality.

Areas of Critical Environmental Concern (ACEC): The BLM has designated over 40 areas within Montana and the Dakotas as ACECs. These areas have received special designations and ACEC management plans have been adopted to protect various unique resources and values. Many of the ACEC management plans under Alternative A did not address fire management. The proposed fire management plan (Alternative B) does provide resource considerations which are used in developing for each ACEC, fire management objectives and guidance for wildland fire suppression and rehabilitation as well as guidance for prescribed fire and other hazardous fuels reduction efforts. This information is contained in the Fire Management Plan for each Field Office (Appendices B-J). The proposed special fire management guidance for ACECs is summarized in Table 4. Impacts to the ACEC resources and values are described below by resource or value.

TABLE 4 ACEC MANAGEMENT GUIDANCE

Field Office	ACEC Name	Size (Acres)	Reason for Designation	Proposed Special Fire Management Guidance
Billings	Four Dances (proposed)	765	Archeological, cultural, scenery, natural hazards, historic	See Appendix B, Common guidance for fire suppression and prescribed fires, and guidance specific to Billings Grasslands.
Billings	East Pryor Mountains	29,500	Wildlife, Wild Horses, Paleontology	See Appendix B, Common guidance for fire suppression and prescribed fires, and guidance specific to Pryor Mountains.
Billings	Weatherman Draw	4,268	Cultural	See Appendix B, Common guidance for fire suppression and prescribed fires, and guidance specific to Billings Grasslands.
Billings	Meeteetse Spires	960	Rare Plant, Hazardous Cliffs, Scenery	See Appendix B, Common guidance for fire suppression and prescribed fires, and guidance specific to Billings Grasslands.
Billings	Bridger Fossil	575	Paleontology	See Appendix B, Common guidance for fire suppression and prescribed fires, and guidance specific to Billings Grasslands.
Billings	Stark Site	800	Cultural	See Appendix B, Common guidance for fire suppression and prescribed fires, and guidance specific to Billings Grasslands.
Billings	Petroglyph Canyon	240	Cultural	See Appendix B, Common guidance for fire suppression and prescribed fires, and guidance specific to Billings Grasslands.
Billings	Pompeys Pillar	470	Historic, Cultural, Recreation	See Appendix B, Common guidance for fire suppression and prescribed fires, and guidance specific to Pompeys Pillar.
Billings	Castle Butte	185	Cultural	See Appendix B, Common guidance for fire suppression and prescribed fires, and guidance specific to Billings Grasslands.

TABLE 4 ACEC MANAGEMENT GUIDANCE (continued)				
Field Office	**ACEC Name**	**Size (Acres)**	**Reason for Designation**	**Proposed Special Fire Management Guidance**
Butte	Sleeping Giant	11,609	Recreation, Scenic, Fish & Wildlife	See Appendix C, Common guidance for fire suppression and prescribed fires, and guidance specific to Sleeping Giant/Sheep Creek.
Lewistown	Sweetgrass Hills	7,952	Cultural, T&E, Wildlife, Recreation	See Appendix E, Common guidance for fire suppression and prescribed fires, and guidance specific to Prairie Grass, Brush, and Agricultural Lands.
Lewistown	Kevin Rim	4,657	Fish & Wildlife, Cultural Resources, Recreation	See Appendix E, Common guidance for fire suppression and prescribed fires, and guidance specific to Prairie Grass, Brush, and Agricultural Lands.
Lewistown	Acid Shale-Pine Forest	2,463	Endemic Plant Community	See Appendix E, Common guidance for fire suppression and prescribed fires, and guidance specific to Prairie Grass, Brush, and Agricultural Lands.
Lewistown	Judith Mountains Scenic Area	3,702	Scenic, Wildlife, Recreation	See Appendix E, Common guidance for fire suppression and prescribed fires, and guidance specific to Judith Mountains.
Lewistown	Collar Gulch	1,618	Westslope Cutthroat Trout	See Appendix E, Common guidance for fire suppression and prescribed fires, and guidance specific to Judith, North and South Moccasin, Little Snowy Mountains.
Lewistown	Square Butte ONA	1,947	Natural Endemic Systems, Cultural, Scenic, Geologic	See Appendix E, Common guidance for fire suppression and prescribed fires, and guidance specific to Prairie Grass/Brush and Agricultural Lands.
Lewistown	Cow Creek	14,000	Riparian, Natural Hazard, Geological, Scenic, Natural System	See Appendix E, Common guidance for fire suppression and prescribed fires, and guidance specific to Missouri Breaks.
Malta	Prairie Dog Towns	12,346	Habitat For Black-Footed Ferret Reintroduction	See Appendix F, Common guidance for fire suppression and prescribed fires, and guidance specific to Grass and Range Lands.
Malta	Big Bend of the Milk River	2,120	Archaeological Resources	See Appendix F, Common guidance for fire suppression and prescribed fires, and guidance specific to Grass and Range Lands.
Malta	Azure Cave	140	Cave Resources, Bats	See Appendix F, Common guidance for fire suppression and prescribed fires, and guidance specific to Little Rocky Mountains, Timber.
Miles City	Powder River Depot	1,386	Cultural	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.

TABLE 4 ACEC MANAGEMENT GUIDANCE (continued)				
Field Office	**ACEC Name**	**Size (Acres)**	**Reason for Designation**	**Proposed Special Fire Management Guidance**
Miles City	Hell Creek	19,169	Paleo	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Sand Arroyo	9,056	Paleo	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Smoky Butte	80	Geology, Recreation	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Black-footed Ferret	11,166	Wildlife	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Piping Plover	16	Wildlife	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Jordan Bison Kill	160	Cultural	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Seline	80	Cultural	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Ash Creek Divide	7,931	Paleo	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Hoe	144	Cultural	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Big Sheep Mountain	360	Cultural	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Bug Creek	3,840	Paleo	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.

TABLE 4 ACEC MANAGEMENT GUIDANCE (continued)				
Field Office	**ACEC Name**	**Size (Acres)**	**Reason for Designation**	**Proposed Special Fire Management Guidance**
Miles City	Finger Buttes	1,520	Scenery	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Howrey Island	321	T&E Wildlife	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Battle Butte	120	Cultural	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Reynolds Battlefield	336	Cultural	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Miles City	Ash Creek Divide	7,931	Paleontology	See Appendix G, Common guidance for fire suppression and prescribed fires, and guidance specific to Special Management Areas.
Missoula	Bear Creek Flats	564	Riparian, Fish, T&E Species, Wildlife, Old Growth Pine, Recreation	See Appendix H, Common guidance for fire suppression and prescribed fires, and guidance specific to Blackfoot.
Missoula	Rattler Gulch Limestone Cliffs	20	Geological	See Appendix H, Common guidance for fire suppression and prescribed fires, and guidance specific to Clark Fork Front.
Missoula	Squaw Rock	640	Fish, Wildlife, Recreation, Scenic	See Appendix H, Common guidance for fire suppression and prescribed fires, and guidance specific to Flintrock.
South Dakota	Fort Meade Recreation Area	6,700	Historic, Cultural	See Appendix J, Common guidance for fire suppression and prescribed fires, and guidance specific to Fort Meade Recreation Area ACEC.
South Dakota	Fossil Cycad	321	Paleontology	See Appendix J, Common guidance for fire suppression and prescribed fires, and guidance specific to Remainder of the South Dakota Field Office.

Cultural Resources: Archaeological resources which are considered eligible for the National Register of Historic Places (NRHP) should either be avoided or, in consultation with the State Historic Preservation Officer (SHPO), a plan for mitigating the effects of the proposed actions should be formulated and implemented. Past management (Alternative A) has been inconsistent in the application of guidance for cultural resource protection from wildland fire. The proposed fire management plan (Alternative B) does provide fire management objectives and guidance for wildland fire suppression and rehabilitation as well as guidance for prescribed fire and other hazardous fuels reduction efforts to protect cultural resources.

Environmental Justice: Neither alternative would have disproportionately high or adverse effects on human health or environmental effects on low-income or minority populations, as provided for under Environmental Justice considerations.

Farm Lands (Prime or Unique): The Farmland Protection Policy Act of 1985 and 1995 requires identification of proposed actions that would affect any lands classified as prime and unique farmlands. The purpose of the Act is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. Neither the wildland fire suppression and rehabilitation nor the prescribed burning anticipated with either alternative would contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses.

Floodplain: No developments or effects of development by the BLM would be anticipated in a floodplain with either alternative. Executive Order 11988 was enacted to “avoid to the extent possible the long-term and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative.”

Invasive and Non-Native Species: Some of the activities and land uses would introduce and/or spread noxious weeds. The management guidelines, description of impacts, and resource considerations (Appendix A) provide specific discussion of invasive and non-native species guidance. The proposed alternative (Alternative B) would provide clearer guidance for wildland fire suppression, rehabilitation, prescribed burning, and other hazardous fuels reduction efforts.

Native American Religious Concerns: Neither alternative would interfere with the inherent right of freedom to believe, express, and exercise traditional religions, including access to religious sites, use and possession of sacred objects, and freedom to worship through ceremonials and traditional rites as established in the American Indian Religious Freedom Act of 1978.

Threatened or Endangered Species: Fire related actions were analyzed concerning impacts to threatened or endangered species and impacts to habitat of such species as provided for in the Endangered Species Act of 1973. In Montana and the Dakotas, 7 species are listed as endangered, 6 are listed as threatened, and 1 is proposed. Designated BLM sensitive species include 26 species of birds, 15 species of mammals, 7 species of reptiles and amphibians, 11 species of fish, and 28 species of plants. Table 5 summarizes the presence of species by Field Office that are federally listed as Threatened or Endangered and species proposed for federal listing. In addition, standards are listed which are necessary to reduce potential adverse effects. These standards are required mitigation to insure that effects from the proposed action would be insignificant or discountable and therefore Not Likely to Adversely Affect the species.

Wastes, Hazardous or Solid: Activities associated with either alternative should be conducted to be in compliance with the Resource Conservation and Recovery Act (RCRA) which provides “cradle to grave” control of hazardous waste and solid wastes by imposing management requirements on generators and transporters of the wastes. Spills of retardant, fuels, and other chemicals may be subject to the spill reporting requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or Clean Water Act. These reporting requirements are contained in the National Contingency Plan (40 CFR Part 300). In general, with “proper housekeeping procedures”, compliance with these environmental laws and regulations should not be a significant concern for any of the activities associated with the two alternatives.

Water Quality: The Safe Drinking Water Act of 1974 establishes protective measures for culinary water systems by providing standards which regulate allowable contaminant levels. This would not be affected by either fire management alternative. The Clean Water Act as amended by The Water Quality Act of 1987 provides national policy and mandates the control of non-point sources of pollution. Agencies are to develop and implement programs to meet the goals of this act through the control of both point and non-point pollution. Appendix A contains guidance related to water quality.

Wetlands/Riparian Zones: The impacts to riparian zones and wetlands were considered and addressed in the impact analysis. Management considerations must comply with Executive Order 11990, Protection of Wetlands, which

TABLE 5 REQUIRED THREATENED AND ENDANGERED SPECIES MITIGATION STANDARDS		
Species (Status) **(E) Endangered** **(T) Threatened** **(P) Proposed**	**Field Offices* With Documented Occurrence**	**Standards for fire suppression, prescribed burning, and other fuel reduction efforts.** **See Appendix A for complete standards.**
Bald Eagle (E)	MT 010,020,030,040,050,064,070,092,100	BE1,BE2,BE3,BE4,BE5
Least tern (interior population) (E)	MT 020,030,040	LT1,LT2,LT3,LT4
Mountain Plover (P)	MT 010,020,060,064,070,090,092	MP1,MP2,MP3,MP4
Piping Plover (T)	MT 020	PP1,PP2,PP3,PP4
Whooping Crane (E)	MT 020, 050	WC1,WC2,WC3,WC4
Black-footed ferret (E)	MT 040, 090	BF1,BF2,BF3
Canada Lynx (T)	MT 050, 070, 100	CL1,CL2,CL3,CL4,CL5,CL6,CL7
Gray Wolf (E)	MT 010,050, 070, 100	GW1,GW2
Grizzly Bear (E)	MT 060,050,100	GB1,GB2,GB3,GB4,GB5,GB6
Bull Trout (T)	MT 100	BT1
Pallid Sturgeon (E)	MT 020,030,040,060 ,064, 090,092	PS1,PS2
Ute Ladies'-tresse (T)	MT 050, 070	UL1,UL2,UL3,UL4,UL5
Water Howellia (T)	none	WH1,WH2,WH3,WH4,WH5
Western Prairie Fringed Orchid (T)	none	WP1,WP2,WP3,WP4,WP5

*010 = Billings Field Office (FO)
020 = Miles City FO
030 = North Dakota FO
040 = South Dakota FO
050 = Dillon FO
060 = Lewistown FO
064 = Havre Field Station
070 = Butte FO
090 = Malta FO
092 = Glasgow Field Station
100 = Missoula FO

requires federal agencies to minimize the destruction, loss, or degradation of wetlands while preserving and enhancing their natural and beneficial values on federal property. The order restricts most activities that could potentially affect wetlands administered by the Federal government. Activities mentioned in the EO include federal activities and programs affecting land use.

Wild and Scenic Rivers: BLM currently manages only one area designated as a Wild and Scenic River. The Upper Missouri National Wild and Scenic River (UMNWSR) is located between Fort Benton and US Highway 191 in northcentral Montana. This 149 mile stretch of river flows generally west to east through Chouteau, Blaine, Fergus and Phillips counties. Fire management guidance from the Upper Missouri National Wild and Scenic River management plan is incorporated into the proposed fire management plan (Alternative B) for the Lewistown and Malta Field Offices.

Wilderness: Forty BLM sites with a total of 452,563 acres within Montana are Wilderness Study Areas (WSAs) and one 6,000 acre site is a Wilderness Area. Wilderness Areas and WSAs are shown on Map 2. The WSAs meet the criteria set forth for potential wilderness designation under the Wilderness Act of 1964, which includes size, influence of man, absence of human habitation, and provides opportunities for solitude or primitive and unconfined type of recreation. All Wilderness and WSAs are classified as VRM Class I unless specifically exempted from this classification in a Resource Management Plan.

Because of their designations as WSAs or Wilderness, and due to their Class I VRM designation, special consideration and restrictions must be applied in wildland fire suppression, rehabilitation, prescribed fire and other hazardous fuel reduction efforts in these areas. This guidance and direction is contained in Appendix A, and also in the Fire Management Plan for each Field Office (Appendices B-J). Table 6 groups these areas by Field Office.

MAP 2
WILDERNESS AND WILDERNESS STUDY AREAS

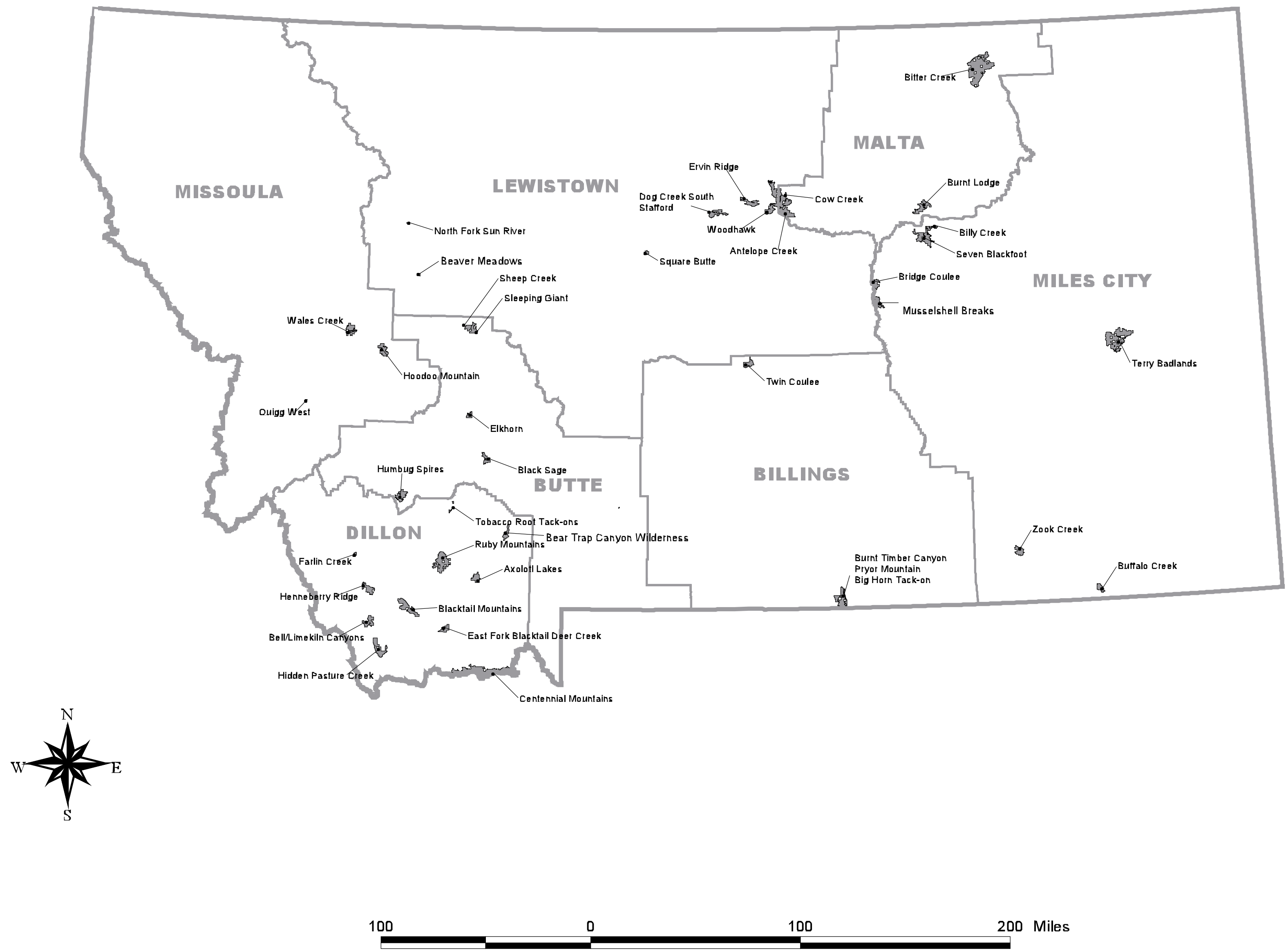

TABLE 6 BLM WILDERNESS AND WILDERNESS STUDY AREAS			
FIELD OFFICE	**WSA or WILDERNESS**	**ACRES**	**CATEGORY AND FIRE MGMT. ZONE**
BILLINGS	Burnt Timber Canyon MT-067-205	3,430	Category B. Pryor Mountain FMZ
	Pryor Mountain MT-067-206	13,397 (4,352 additional acres of the Pryor WSA in Wyoming)	Category B. Pryor Mountain FMZ
	Big Horn Tack On MT-067-207	3,308 (353 additional acres of BH tack-on in Wyoming)	Category B. Pryor Mountain FMZ
	Twin Coulee MT-067-212	6,870	Category B. Twin Coulee WSA FMZ
BUTTE	Humbug Spires MT-ISA-003	11,175	Category C. McCartney-Rochester FMZ
	Sleeping Giant/Sheep Creek MT-075-111	10, 454	Category C. Sleeping Giant-Sheep Creek FMZ
	Black Sage MT-075-115	5,926	Category C. Three Forks FMZ
	Yellowstone River Island MT-074-133	53	Category A. Bozeman-Livingston Scattered Tracts FMZ
	Elk Horn MT Section 202 MT-075-114	(3,585)	Category C. Elkhorn Mountains FMZ
DILLON	Bear Trap Canyon **Wilderness**	6000	Category C. East Madison FMZ
	Ruby Mountains MT-076-001	26,611	Category D. North Rubys FMZ
	Blacktail Mountains MT-076-002	17,497	Category C. Blacktail Mountains FMZ
	East Fork, Blacktail Deer Creek MT-076-007	6,230	Category C. Sweetwater-Ruby FMZ
	Hidden Pasture Creek MT-076-022	15, 509	Category C. Tendoy Mountains FMZ
	Bell/Limekiln Canyons MT-076-026	9,650	Category C. Tendoy Mountains FMZ
	Henneberry Ridge MT-076-028	9,806	Category C. Blacktail-Horse Prairie FMZ
	Farlin Creek MT-076-034	1139	Category C. Southeast Foothills-Pioneers FMZ
	Axolotl Lakes MT-076-069	7,804	Category C. Gravelly Mountains FMZ
	Centennial Mountains MT-ISA-002	27,691	Category C. Centennial FMZ
	Tobacco Root Tack On (SECTION 202)	(860)	Category C. Tobacco Root Mountains FMZ

TABLE 6 (continued) BLM WILDERNESS AND WILDERNESS STUDY AREAS			
FIELD OFFICE	**WSA or WILDERNESS**	**ACRES**	**CATEGORY AND FIRE MGMT. ZONE**
LEWISTOWN	Square Butte MT-ISA-004	1,947	Category B. Prairie Grass, Brush, and Agricultural Lands FMZ
	Stafford MT-068-250	4,800	Category C. Missouri Breaks FMZ
	Ervin Ridge MT-068-253	10,200	Category C. Missouri Breaks FMZ
*Management responsibility is shared with Malta FO	Cow Creek MT-066-256	34,050	Category C. Missouri Breaks FMZ
	Dog Creek South MT-068-244	5,150	Category C. Missouri Breaks FMZ
	Woodhawk MT-068-246	8,100	Category C. Missouri Breaks FMZ
	Beaver Meadows Section 202	(595) Study incomplete	Category B. Prairie, Grass, Brush and Agricultural Lands FMZ
	North Fork Sun River Section 202	(196) Study incomplete	Category C. Rocky Mountain Front FMZ
MALTA	Burnt Lodge MT-065-278	13,730	Category B. Grass and Range Lands FMZ
	Bitter Creek MT-064-356	59,600	Category B. Grass and Range Lands FMZ
	Antelope Creek MT-065-266	12,350	Category C. Missouri Breaks FMZ
MILES CITY	Billy Creek MT-024-633	3,450	Category C. Special Management Areas FMZ
	Seven Blackfoot MT-024-657	20,330	Category C. Special Management Areas FMZ
	Bridge Coulee MT-024-657	5,900	Category C. Rural Interface FMZ
	Musselshell Breaks MT-024-677	8,650	Category C. Rural Interface FMZ
	Terry Badlands MT-024-684	44,910	Category B. Rural Interface FMZ
	Zook Creek MT-027-701	8,438	Category C. Special Management Areas FMZ
	Buffalo Creek MT-027-702	5,650	Category C. Special Management Areas FMZ
MISSOULA	Wales Creek MT-074-150	11,580	Category C. Blackfoot FMZ
	Hoodoo Mountain MT-074-151A	11,380	Category C. Hoodoo FMZ
	Quigg West MT-074-155	520	Category B. Flintrock FMZ

Vegetation

Prior to European settlement, fire was the most common and widespread influence on the landscape in the intermountain west (Gruel 1983). The break-up and reduction of fuels caused by grazing and cultivation that came with European settlement, and then the introduction of organized fire suppression, have caused a drastic decrease in fire occurrence and size (Gruell 1983; Swetnam 1990). With the omission of fire as a dominant ecological factor on many sites has come significant changes in vegetation. Successional changes that have occurred on some sites would unlikely have occurred in the pre-European settlement environment, where frequent fires suppressed woody vegetation (Gruell 1983). Increase in density of woody species has occurred on some sites, as well as invasion of woody species onto sites where frequent fire used to preclude their dominance. Fire exclusion has had the most marked effect on ecotones, tension zones between two different community types. Natural fires replaced fire sensitive woody species with species that were more fire adapted.

Fire affects the productivity of plants. Where fire is precluded, plant communities may be affected by increased plant competition. The extent of these impacts depends on weather conditions before and after a burn; time of the year (whether plants are growing or dormant); physical features of the site; particular species; plant life form (shrub, grass, tree, and so forth), method of reproduction, stage of maturity and vigor; amount of fuel available and its moisture content; severity and intensity of the burn; rate of fire spread; flame length; depth and duration of heat penetration into organic and soil layers; and frequency of fires. Prefire and postfire management also affects composition and productivity of plant communities.

Fire can affect postfire plant productivity. Productivity may decrease during the initial postfire recovery period, then increase after several years. Productivity may increase after the first growing season. Total productivity may not change, but it can shift among classes of plants on the site, such as from conifers that are killed by a fire to shrubs, grasses, and forbs. Total vegetative productivity may actually decrease but shift from less desirable to more desirable species, as from woody plants to grasses and forbs. Immediate productivity increases are usually more likely if vegetative reproduction or regeneration occur, than if the site must reestablish from seed.

Fire can affect plant competition by changing the numbers and species of existing plants or altering site conditions. In a postfire situation, established perennial plants usually have an advantage over plants that are developing from seed, because they take up water and nutrients from an existing root system while seedings must develop a new root system. Sprouting plants may rapidly develop a crown that can shade out other plants or limit their growth. Natural regeneration of shrubs may severely limit growth of naturally occurring or planted conifers because of competition for light or moisture (Stein 1986). Grass seeded for postfire erosion control in forested areas may overtop conifer seedlings. Litter from seeded grasses may also increase the flammability at the site to much higher levels than would occur if only native vegetation recovered on the site (Cohen 1986 as cited in Barro and Conard 1987). A second fire after a short-term interval might kill all seedlings of native species before they have produced much seed. Therefore, numbers and vigor of native plants would be further reduced. Cheatgrass seedlings can grow roots at much cooler soil temperatures than many native perennial grass seedlings and use up soil moisture in the spring before other species get their roots down into the soil profile (Thill et al. 1984).

On sites that are not burned, some species may have a competitive advantage. For example, junipers can take up increasing amounts of soil water in sagebrush/grass communities they have invaded and eventually exclude most other species because of moisture limitations. Grass production tends to decrease as sagebrush cover increases, again because of competition for water. Young stands of conifers that develop in the absence of fire beneath mature overstories of ponderosa pine compete with the mature trees for moisture and nutrients, weakening them and making them susceptible to insects and disease. Depending on the site, prescribed fire or fire in combination with other treatments is often the most efficient and ecologically sound way to manage these plant communities.

If burning occurs in close association with heavy use of the plant community by livestock or wildlife, either before or after the burn, plant recovery may be delayed or prevented because heavy prefire use may deplete plant carbohydrate reserves. Heavy postfire use of perennial plants in the first growing season after a fire is likely to cause the most harm, particularly in arid and semi-arid range communities (Trlica 1977). Livestock and wildlife are often attracted to burned areas because of increased palatability, availability, and the earlier spring greenup that often occurs on burned rangelands and grasslands. In most cases two full growing seasons at postfire rest are necessary before plants can sustain much utilization (Wright and Bailey 1982). A longer recovery period is necessary if weather has been unfavorable for growth or if establishment of plants from seeds is required to completely revegetate the site. Desert plants required more than seven years of recovery after moderate defoliation (Cook and Child 1971, as cited in Trlica 1977), and some shrubland sites may require lengthy postfire rest if recovery of browse species is desired.

For some plant communities in poor condition or dominated by undesirable species, it may be necessary to artificially reseed the area after burning because natural revegetation by desired species is unlikely to occur.

The observed responses of plants to fires depend on the above factors and other localized conditions. Because these factors determine the outcome of a particular wildland fire or prescribed burn, onsite management decisions can alter fire effects to meet specific goals.

In general, prescribed fires are planned with specific goals and conducted under constraints to ensure that the fire is contained, that fire and resource objectives are met, and that long-term site productivity is maintained or enhanced.

A particular plant species may or may not be considered desirable on a treatment site, depending on the specific objective of the treatment. The following describes broad groups of plant species and the effects of fire on the species or group of species.

Table 7 shows the percentage of landcover type on BLM land by fire management zone. Table 8 shows the total amount of each type of landcover and the percent managed by the BLM in each fire management zone.

TABLE 7
PERCENT LAND COVER* ON BLM LAND BY FIRE MANAGEMENT ZONE

Fire Management Zone	Acres of BLM	Urban/ Agriculture	Grass lands	Shrub lands	Forest lands	Riparian
Billings Field Office						
1. Billings Grasslands	232,500	1%	43%	47%	3%	6%
2. Roundup	83,200	<1%	48%	44%	7%	1%
3. Pryor Mountains	38,800	–	42%	30%	26%	2%
4. Big Timber/Absaroka	18,100	–	38%	12%	48%	2%
5. Twin Coulee WSA	7,000	—	3%	3%	94%	<1%
6. Pompeys Pillar Nat. Monument / ACEC	450	44%	4%	11%	—	41%
Butte Field Office						
1. Absaroka Foothills	3,900	—	25%	17%	58%	—
2. Big Belt Mountains	1,300	—	51%	4%	45%	—
3. Big Hole River Corridor	7,300	<1%	37%	55%	7%	—
4. Blackfoot (See Missoula FO)	74,500	—	11%	4%	85%	—
5. Boulder River	14,200	<1%	14%	14%	72%	—
6. Clancy/Marysville	26,000	—	28%	6%	66%	—
7. Elkhorn Mountains	68,500	<1%	31%	25%	44%	—
8. Fleecer Mountains	17,900	<1%	11%	39%	50%	—
9. Hoodoo (See Missoula FO)	33,500	—	5%	3%	92%	—
10. McCartney/Rochester	27,500	<1%	32%	34%	34%	—
11. North Hills	6,400	—	28%	8%	64%	—
12. Pipestone	40,500	<1%	52%	15%	33%	—
13. Scratchgravel Hills	2,900	<1%	86%	1%	13%	—
14. Sleeping Giant/Sheep Creek	9,800	—	43%	2%	55%	—
15. Spokane Hills and North	6,500	—	40%	6%	54%	—
16. Three Forks	29,700	<1%	52%	15%	33%	<1%
17. Wise River Townsite	1,300	—	8%	29%	63%	—
18. Bozeman/Livingston Scattered Tracts	*Information on acreage totals and composition is unknown*					

TABLE 7 (continued)
PERCENT LAND COVER* ON BLM LAND BY FIRE MANAGEMENT ZONE

Fire Management Zone	Acres of BLM	Urban/ Agriculture	Grass lands	Shrub lands	Forest lands	Riparian
Dillon Field Office						
1. Beaverhead Mountains	29,750	2%	12%	39%	44%	3%
2. Beaverhead/Jefferson	21,700	<1%	68%	20%	12%	–
3. Big Hole River Corridor	7,300	<1%	37%	55%	7%	–
4. Big Sheep/Medicine Lodge Backcountry Byway	49,800	<1%	17%	69%	11%	2%
5. Blacktail Mountains	21,700	–	28%	8%	64%	–
6. Blacktail/Horse Prairie	241,200	<1%	26%	70%	3%	<1%
7. Centennial	146,100	<1%	26%	50%	24%	–
8. East Madison	11,200	–	36%	8%	56%	–
9. Gravelly Mountains	38,400	<1%	26%	8%	66%	–
10. Madison Valley	20,700	<1%	50%	26%	24%	–
11. McCartney/Rochester	94,300	<1%	67%	27%	6%	–
12. North Rubys	26,800	–	11%	6%	83%	–
13. SE Foothills/Pioneers	101,200	<1%	29%	64%	7%	<1%
14. Sweetwater/Ruby	89,000	<1%	27%	54%	19%	–
15. Tendoy Mountains	55,900	<1%	18%	64%	16%	1%
16. Tobacco Root Mountains	31,600	<1%	38%	22%	39%	–
17. Wise River Townsite	1300	–	12%	28%	60%	–
Lewistown Field Office						
1. Judith	23,700	<1%	10%	4%	84%	2%
2. Little Snowy Mountains	9,000	–	18%	5%	75%	2%
3. Missouri Breaks	563,900	<1%	37%	43%	18%	2%
4. North and South Moccasins	4,700	–	13%	4%	79%	4%
5. Prairie Grass/Brush & Ag. Lands	689,500	3%	74%	14%	7%	2%
6. Rocky Mountain Front	13,300	–	25%	24%	50%	1%
Malta Field Office						
1. Grass & Range Lands	1,659,300	1%	61%	35%	1%	2%
2. Little Rocky Mountains, Timber	28,600	–	15%	6%	77%	2%
3. Missouri Breaks Uplands	18	–	33%	45%	5%	17%
Miles City Field Office						
1. Rural Interface Areas	10,300	1%	55%	24%	18%	2%
2. Special Management Areas	70,500	<1%	42%	34%	23%	1%
3. Missouri-Musselshell River Breaks	171,700	<1%	43%	35%	21%	<1%
4. Knowlton-Locate	12,300	–	48%	25%	23%	4%
5. Custer National Forest	136,100	<1%	38%	43%	17%	2%
6. Cedar Breaks	48,500	<1%	70%	17%	11%	1%
7. Mixed Grass Prairie-Sagebrush	1,904,000	<1%	60%	33%	3%	3%
Missoula Field Office						
1. Blackfoot	74,500	–	11%	4%	85%	–
2. Clark Fork Front	18,500	<1%	17%	7%	76%	–
3. Flintrock	25,700	<1%	19%	6%	74%	<1%
4. Hoodoo	33,500	–	5%	3%	92%	–
North and South Dakota Field Offices						
Information on Landcover Type and acreage unavailable						

*Information derived from The Montana Gap Analysis Project (Sept. 1998)

TABLE 8
LAND COVER* BY FIRE MANAGEMENT ZONE

Fire Management Zone	Urban/Agriculture		Grasslands		Shrublands		Forest Lands		Riparian	
	Total Acres	% BLM	Total Acres	% BLM	Total Acres	% BLM	Total Acres	% BLM	Total Acres	% BLM
Billings Field Office										
1. Billings Grasslands	1,071,000	<1	3,670,000	3	2,179,600	5	1,114,200	<1	730,500	2
2. Roundup	52,600	<1	348,300	12	226,200	16	172,000	3	26,700	3
3. Pryor Mountains	197	–	40,000	40	28,700	40	50,700	40	3,400	2
4. Big Timber/Absaroka	31,100	–	397,600	2	112,500	2	152,600	6	54,900	<1
5. Twin Coulee WSA	–	–	1,000	19	700	28	10,800	62	200	18
6. Pompeys Pillar Nat. Monument / ACEC	230	87%	20	100	50	100	–	–	180	100
Butte Field Office										
1. Absaroka Foothills	4950	–	24,400	4	4750	14	31,700	7	700	–
2. Big Belt Mountains	200	–	83,400	<1	13,300	<1	50,000	1	850	–
3. Big Hole River Corridor	1,100	1	11,700	23	16,500	24	21,200	3	–	–
4. Blackfoot (See Missoula FO)	8,300	–	116,400	7	23,700	13	231,000	27	–	–
5. Boulder River	600	1	44,500	4	17,600	12	209,300	5	–	–
6. Clancy/Marysville	4,500	–	81,300	9	15,400	10	164,600	10	–	–
7. Elkhorn Mountains	29,900	<1	166,800	13	63,400	27	204,700	15	–	–
8. Fleecer Mountains	5,400	<1	81,200	2	53,600	13	137,700	6	–	–
9. Hoodoo (See Missoula FO)	400	–	209,100	<1	43,600	2	179,800	17	–	–
10. McCartney/Rochester	400	1	29,600	30	19,400	48	31,000	30	–	–
11. North Hills	1,000	–	15,000	12	3,800	13	10,900	38	–	–
12. Pipestone	13,800	<1	163,800	13	25,500	24	159,300	8	–	–
13. Scratchgravel Hills	8,300	<1	34,200	7	3,900	1	11,200	3	–	–
14. Sleeping Giant/Sheep Creek	–	–	4,200	97	200	100	5,800	92	–	–
15. Spokane Hills and North	18,300	–	69,000	4	7,000	6	26,300	13	–	–
16. Three Forks	23,400	<1	226,200	7	50,600	9	48,850	20	2,500	1
17. Wise River Townsite	–	—	4,000	3	2,200	17	2,300	35	–	–
18. Bozeman/Livingston Scattered Tracts	*Information on Landcover type and acreage unavailable*									
Dillon Field Office										
1. Beaverhead Mountains	19,100	3	117,900	3	101,600	11	509,900	3	23,000	4
2. Beaverhead/Jefferson	133,700	<1	437,000	3	93,900	5	36,000	7	–	–
3. Big Hole River Corridor	1,100	1	11,700	23	16,500	24	21,200	3	–	–
4. Big Sheep/Medicine Lodge Backcountry Byway	1,600	3	19,000	45	62,200	5	11,300	50	7,600	15
5. Blacktail Mountains	–	–	11,400	53	5,900	30	18,100	76	–	–
6. Blacktail/Horse Prairie	19,000	2	200,500	35	373,000	51	40,500	26	30,700	4
7. Centennial	8,200	<1	207,600	18	240,800	30	94,500	38	–	–
8. East Madison	4,100	–	91,100	4	13,400	7	282,000	2	400	–
9. Gravelly Mountains	800	<1	262,800	4	48,300	7	314,700	8	–	–

10. Madison Valley	32,300	<1	261,200	4	68,500	1	42,100	11	–	–
11. McCartney/Rochester	7,300	1	128,400	49	46,200	56	22,300	25	–	–
12. North Rubys	600	–	7,300	23	3,400	24	13,800	87	–	–
13. SE Foothills/Pioneers	6300	<1	65,100	45	114,300	57	32,400	21	2,400	11
14. Sweetwater/Ruby	3,200	<1	117,700	20	166,200	29	39,700	43	–	–
15. Tendoy Mountains	600	6	31,000	33	65,700	54	35,100	26	3,300	27
16. Tobacco Root Mountains	4,400	<1	88,700	14	31,400	23	171,700	7	–	–
17. Wise River Townsite	–	–	4,000	3	2,200	17	2,300	35	–	–
Lewistown Field Office										
1. Judith	9,800	1	74,300	3	15,200	6	56,700	35	15,800	2
2. Little Snowy Mountains	–	–	25,000	6	6,000	7	39,900	17	4,300	4
3. Missouri Breaks	107,300	3	583,400	36	451,700	54	154,000	68	9,500	17
4. North and South Moccasins	5	–	2,500	24	800	26	10,400	36	900	21
5. Prairie Grass/Brush & Ag. Lands	6,229,000	<1	9,151,300	6	1,237,700	8	1,545,100	3	669,300	2
6. Rocky Mountain Front	–	–	23,700	14	19,800	16	33,300	20	1,100	13
Malta Field Office										
1. Grass & Range Lands	949,500	2	2,541,700	40	885,700	65	51,100	26	166,900	21
2. Little Rocky Mountains, Timber	50	–	28,300	15	6,700	26	25,800	86	2,000	27
3. Missouri Breaks Uplands	1400	–	80,300	–	165,100	–	57,700	–	6,800	–
Miles City Field Office										
1. Rural Interface Areas	10,500	1	47,400	12	12,900	19	22,800	8	5,400	3
2. Special Management Areas	6,400	1	77,700	38	46,500	52	25,200	64	6,500	14
3. Missouri-Musselshell River Breaks	36,700	1	235,100	31	125,100	48	80,100	46	6,900	9
4. Knowlton-Locate	34	<1	18,000	33	9,000	34	5,800	48	1,900	30
5. Custer National Forest	86,100	<1	704,000	7	476,200	12	350,700	7	89,200	3
6. Cedar Breaks	600	13	69,300	49	18,500	43	9,500	58	2,600	28
7. Mixed Grass Prairie-Sagebrush	3,515,900	<1	9,958,500	12	4,028,500	16	641,600	9	944,500	6
Missoula Field Office										
1. Blackfoot	8,300	–	116,400	7	23,700	13	231,000	27	–	–
2. Clark Fork Front	2,900	<1	42,200	5	16,200	8	187,300	7	–	–
3. Flintrock	11,500	–	214,600	2	54,400	3	380,900	5	2,600	5
4. Hoodoo	400	–	209,100	<1	43,600	2	179,800	17	–	–
North and South Dakota Field Offices										
Information on Landcover Type and acreage not available										

*Information derived from the Montana Gap Analysis Project (Sept. 1998)

Grasslands: Grasslands occur at elevations ranging from 3,000 to over 9,000 feet where annual precipitation varies from 8 to 30 inches (Garrison 1977, Mueggler and Stewart 1980), at least half of which usually falls during the growing season. Grasslands occupy a variety of topographical positions, from level areas or valley floors, to alluvial benches and foothills, to steep mountain slopes. Soil characteristics vary accordingly, ranging from deep and loamy, to poorly drained or fairly dry and rocky, or mildly alkaline to mildly acidic (Mueggler and Stewart 1980). The grass component of these communities is usually the most productive, followed by forbs, and then shrubs.

Important grasses in grass communities include bromes, bluegrasses, sedges, wheatgrasses, fescues, needle grasses, hairgrasses, reedgrasses, bentgrasses, and junegrass. The forb component varies with site, latitude, and management and is diverse throughout the region.

Grasslands are common in eastern Montana and the Dakotas. Sedges and cool season grasses, such as needlegrasses, and wheatgrasses dominate the grassland communities of Montana and North and South Dakota. Warm season grasses, particularly blue grama, are also part of these communities. Other important grasses in mixed grass communities include needlegrass, prairie sandreed, junegrass, sand dropseed, buffalograss, side-oats grama, and little bluestem. Forbs may also be an important component of these communities.

Tall grass communities in the plains grassland are restricted to certain soil types and areas where grazing history has not been severe (Brown 1985). This type is much more extensive in the true prairie of the Dakotas. Tall grass communities are dominated by big bluestem, little bluestem, Indiangrass, switchgrass, and side-oats grama.

The plains grasslands evolved with grazing by native herbivores, and many of the grasses are well adapted to grazing. Climate is the dominant factor controlling these grasslands, but periodic fire was also an important factor in limiting woody vegetation to mosaics or a savanna situation (Wright et al. 1980). Fire suppression has led to the establishment of fire disclimax associations of shrubs in some areas (Brown 1982).

The effect of fire on grasses depends upon the growth form and how burning influences soil moisture and other environmental and prescribed burning conditions. Many of the grass species are fairly fire resistant and can produce new shoot growth even after moderate to high-severity burns.

When desirable understory plants are present within the sagebrush community, prescribed fire can release these species. Spring or fall fires are most desirable and effective because the soils are moist and cool, and the burning is more selective. Sprouting shrubs such as bitterbrush, mountain snowberry, and gamble oak respond favorably, and perennial grasses are benefited. Burning can be used to increase edge effect and increase plant diversity (Bowns 1990).

Repeated or early summer burning reduces perennial grasses and may allow cheatgrass to invade and maintain populations (Wright and Bailey 1982). Bunchgrasses that contain dense plant material in their bases are more damaged than coarse-stemmed and rhizomatous species (Wright and Bailey 1982). Needle-and-thread grass, needlegrass, and Idaho fescue are the dominant grasses that are easily harmed by fire. Plants that have accumulations of dense culms at their base tend to concentrate heat if the fire occurs during a dry period. Large diameter bunches of these three species have all been reported to sustain more damage from fire than smaller diameter bunches. Both needlegrass species have been observed to reproduce from seed after fires. The greater amount of damage to these plants occurs either if they are burned when actively growing or have green tissue; when they are more sensitive to fire temperatures; or when basal material is very dry, can ignite and smolder, and can concentrate heat. Prescribed fires with an objective of enhancing or maintaining grasses would not be scheduled when key species are more sensitive to fire. Bunchgrass plants that survive a fire can return to preburn coverage and production within 2 years (West and Hassan 1985), but the recovery time may be shorter or much longer, depending on the amount of damage sustained by the plant, its recovery potential, site productivity, postfire weather, and postfire animal use.

Perennial forbs generally respond better to burning than do bunchgrasses (Britton and Ralphs 1978), probably because their growing points are protected by soil layers to a greater extent than are grasses. Fall burning does not harm most forbs because many of them are dry and disintegrated by that time (Wright 1985). However, forbs that are still green are still very susceptible to fall fires (Wright 1985), as are forbs such as some of the Antennaria spp. and Phlox spp. (Pechanec and Stewart 1944) that have growth points at the surface. Perennial forbs can recover from summer burning in one year (West and Hassan 1985). Balsamroot has been observed to respond very well to even a summer wildfire after drought conditions, because it sprouts each year from well below the soil surface (Miller 1987).

Burning grass results in responses similar to those seen in sagebrush-grass communities. Large bunch-grasses are more affected than small grasses with coarse stems, and rhizomatous species tolerate fire well (Everett 1987a). Perennial forbs are usually only slightly damaged by fire, except those mat-forming species such as Antennaria spp. (Wright and Bailey 1982, Everett 1987a). Cheatgrass may increase after burning in these communities (Wright and Bailey 1982) if it is present in the stand or in the area before burning, if few residual native bunchgrass plants remain on the site, or if good postfire grazing management practices are not followed. If bunchgrass communities are in good condition when the site is treated, cheatgrass may persist for only a few years.

Prairie shortgrasses are generally harmed by fires during dry years. Buffalograss, annual bluegrass, and western wheatgrass may take three or more years to recover (Wright and Bailey 1982). During years with above normal spring precipitation, these grasses can tolerate fire with no herbage yield reduction following the first growing season (Wright 1974a). Burning usually increases production of switchgrass but decreases little bluestem production where these grasses occur (Wright and Bailey 1982).

Important mixed prairie grasses include green needlegrass and prairie sandreed (reedgrass). Needlegrass is fairly sensitive to fire, although the effect can be moderated by burning conditions and site characteristics. Needlegrass is less tolerant to fire when soils are dry or where plants are large in diameter and have more fuel (Wright and Klemmedson 1965, as cited in Tirmenstein 1987e). Prairie sandreed is a strongly rhizomatous grass that is fire tolerant when dormant and revegetates a burned area with new shoots from rhizomes. It responds more favorably to spring fires than to fall fires (Lyon and Stickney 1976, as cited in Uchytil 1988).

The tolerance of forbs to burning depends upon the timing of the fire relative to active plant growth (Wright and Bailey 1982). Those forbs that start growing after the burning season are least affected, because they have the entire growing season to recover from any injury that the fire may have caused.

Important native grasses include rough fescue, oatgrasses, and mountain brome. Rough fescue is a large-diameter, coarse stem med bunchgrass that seems well adapted to periodic burning. It is susceptible to damage from fires during hot dry weather, although it has benefited from spring and fall prescribed fires. In areas where it has not been grazed or burned for many years, accumulations of litter may ignite and smolder for a long time after a flaming front has passed, causing basal bud mortality. Fescue is also particularly sensitive to burning during the activate growing season (Sinton 1980 in McMurray 1987e). Antos et al. (1983, as cited in McMurray 1987e) suggest that the most beneficial fire frequencies for rough fescue are about every 5 to 10 years. Little information is available about the response of oatgrasses to fire, although other oatgrass species in the Pacific Northwest are reported to be moderately resistant to fire. One-spike oatgrass, a densely tufted to matted perennial bunchgrass, was reported to increase in basal cover after two spring prescribed fires in southwest Montana (Nimir and Payne 1978). Mountain brome, a short-lived perennial bunchgrass with shallow roots, regained 76 percent of its preburn cover within 12 weeks, compared to a control, after one of those same spring fires studied by Nimir and Payne.

Shrublands: Shrubs are generally less tolerant of fire than grasses. However the season and intensity of fire on shrublands also determines the effects of fire. Detailed information about fire effects is summarized from the Northern Rockies Interagency Fire and Aviation Management Fire Effects Information System found on the internet at www.fs.fed.us/database/feis/welcome.htm.

Sagebrush is the most common category of shrublands in Montana. Dominant species in these communities include basin big sagebrush, black sagebrush steppe, mountain big sage, Wyoming big sage, and silver sagebrush.

Mixed xeric shrubs are associated with dry rocky sites. Dominant species include bitterbrush, creeping juniper, greasewood, mountain mahogany, rabbitbrush, and shadscale. Mixed xeric shrubs are the dominant species with 20 to 50 percent cover. This category of shrublands is found on about eight percent of public lands in Montana.

Other shrub species found in Montana and the Dakotas include juniper, silver sagebrush, buffaloberry, sumac, rabbitbrush, western snowberry, gooseberry, red osier dogwood, common chokecherry, American plum, and greasewood.

Environmental diversity has resulted in a comparable variety of species, subspecies, and varieties of sagebrush adapted to specific habitats (Tisdale and Hironaka 1981). Basin big sagebrush and Wyoming big sagebrush usually dominate between 2,000 and 7,000 feet. Basin big sagebrush occupies deep, well-drained alluvial soils where annual precipitation averages 10 to 16 inches, and Wyoming big sagebrush occupies an 8- to 12-inch precipitation zone on shallow soils (Wright et al. 1979). Mountain big sagebrush can be found at elevations from 5,000 to 10,000 feet where annual precipitation varies from 14 to 20 inches (Wright et al. 1979).

Important shrubs include big sagebrush, black sagebrush, low sagebrush, rabbitbrushes, Mormon tea, bitterbrush, snowberry, and horsebrush (Cronquist et al. 1972). Important perennial grasses associated with these shrub communities include bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, rough fescue, western wheatgrass, Great Basin wildrye, junegrass, Indian ricegrass, squirreltail, muttongrass, needle-and-thread grass, and Thurber needlegrass. Red brome and cheatgrass are introduced annual grasses that have become abundant in some areas.

The most dependable combination of both moisture and temperature conditions favorable for growth occurs for a short period after snowmelt. Growing season precipitation is less dependable for soil moisture recharge, and higher temperatures cause greater evapotranspirative losses. The grasses and forbs depend on resources in the surface soil in the interspaces between shrubs and therefore have a constrained growing period. Sagebrush can draw its moisture and nutrients from deep in the profile or through fibrous roots near the surface, giving it extreme resistance to environmental extremes (West 1983). Sagebrush is also long-lived (in excess of 40 years), has great reproductive capacity through abundant and consistent seed set, and produces secondary chemical compounds in its foliage that probably discourage herbivory (West 1983). Altogether, these characteristics make sagebrush extremely competitive in this environment (West 1983). Sagebrush is killed by fire, however and insects and fire appear to be its primary environmental vulnerabilities (West 1983).

The fire history of shrublands has not been firmly established, but fire was probably uncommon on drier sites because of sparse fuels, and more frequent, averaging 32 to 70 years, on more mesic sites with greater herbaceous production (Wright et al. 1979).

Big sagebrush and other nonsprouting shrubs are almost always killed by fires and may take decades to recover preburn status in the community (Harniss and Murray 1973). The rate of reestablishment depends on the size of the area burned, postfire grazing management practices, and the subspecies of sagebrush. For example, silver sagebrush plants resprout vigorously after spring burning but may suffer extensive mortality after fall burning (White and Cusive 1983). Curlleaf mountain mahogany is an examples of desirable forage shrubs that is damaged by fire. Target sprouting shrubs, such as greasewood, may be top-killed by fire but will resprout as soon as conditions are favorable (Blaisdell 1953, Britton and Ralphs 1978). Bitterbrush is a species of special interest because it has valuable forage and browse qualities. It reproduces from seed and by resprouting. Because bitterbrush plants die of old age, fire seems to be necessary for maintenance of the species, even though mortality of plants during any fire may be high. Mortality is minimized by burning when soils are moist, either in the spring or late in the fall after plants have become dormant and rain has fallen. Mortality is highest when fuel consumption is high.

Sprouting shrubs, such as western serviceberry, true mountain mahogany, chokecherry, winterfat, saltbush, rabbitbrush, and horsebrush, may regrow quickly postburn (Wright et al. 1979), while shrubs such as bitterbrush, broom snakeweed, and curlleaf mountain mahogany may or may not re-sprout, depending upon fire and postfire conditions. (Wright and Bailey 1982).

Another important shrub is silver sagebrush. Plains and mountain silver sagebrush are an exception to most sagebrush species because they are moderately resistant to fire, being able to produce sprouts from roots and rhizomes. Sprouting decreases as fire severity and heat penetration into the soil increases, particularly after fall fires when the soil is dry. Silver sagebrush rapidly regains preburn cover after spring fires, although coverage is decreased significantly after many fall fires (McMurray 1987a, McMurray 1987b). The most beneficial effects were reported after early spring fires (Anderson and Bailey 1980, as cited in Tirmenstein 1986c), and mortality has been reported after both spring and fall fires. Whether a particular plant sprouts after a fire apparently relates to site characteristics, season of burn, fire intensity, and burn severity. The effect of fire upon prickly pear varies with plant height, stem moisture content, and the amount of associated fuel, because the plant itself will not burn (Humphrey 1974, as cited in Holifield 1987e). It can resprout from any surviving root crowns and by adventitious rooting of remaining pad (Holifield 1987e). Postfire death of prickly pear is often caused by postfire damage by insects, rodents, rabbits, and livestock, or by dehydration (Holifield 1987e).

Forest Lands: Forest lands are a composite of the many high-elevation evergreen conifer and deciduous forest types that occur throughout Montana and the Dakotas. Species dominance varies with altitude, latitude, slope aspect or other topographical position, soil characteristics, and climatic regime. The BLM administers small acreages of these diverse forest types. Important forest communities include climax ponderosa pine, seral ponderosa pine, Douglas fir, Douglas fir mixed with other conifers, aspen, lodgepole pine, and spruce fir.

Climax ponderosa pine exists at lower elevations and on warmer, drier sites. The lower contact is typically with juniper woodland or mountain shrub communities. Upper elevation contacts are usually with mixed conifer types. Old growth ponderosa forests are often park-like, with scattered old trees interspersed with groups of young trees. There is typically a well-developed herbaceous understory. Stands were probably kept open by light fires that periodically burned through the understory. Older trees tolerate fire well, but young trees are easily killed (Daubenmire 1952). In the absence of frequent understory fires that historically occurred, many stands of ponderosa pine are now dense and stagnant, with thickets of understory reproduction (Wright and Bailey 1982).

On more mesic sites, ponderosa pine will be replaced by other, less fire-tolerant species without understory fires. Ponderosa pine is associated with western larch and Douglas fir in western Montana, where it grades into more moist western larch and Douglas fir forests at higher elevations or more northerly locations. Because ponderosa pine and western larch are the most fire resistant western trees, frequent underburns would favor these species over Douglas fir or grand fir (Wright and Bailey 1982).

Douglas fir occurs in western Montana, generally between the ponderosa pine and spruce fir zones (Wright and Bailey 1982). Ponderosa pine, western larch, aspen, and lodgepole pine are common seral species in this zone (Wright and Bailey 1982). Associated understories may be dominated by bunchgrasses on the most xeric sites, or may be composed of a sparse shrub layer mixed with grasses and forbs (Wright and Bailey 1982).

Quaking aspen is the most widely distributed native North American tree species (DeByle et al. 1985). Its range coincides closely with Douglas fir. Fire is responsible for the abundance and even-aged structure of most stands throughout the West. Without human intervention, fire appears to be necessary for the continued well-being of aspen on most sites (DeByle et al. 1985), and most stands will die out or be replaced by conifers without disturbance.

Lodgepole pine occurs primarily in western and southcentral Montana. At higher elevations, it gives way to spruce fir forest. Lodgepole pine forms dense, often pure stands with little understory. Fire plays an important role in the maintenance of these forests. The Rocky Mountain lodgepole pine contains some proportion of closed cones that retain seeds but quickly release them after fire or cutting (Lotan et al. 1981). Lodgepole pine colonizes burned areas, frequently replacing previous stands of lodgepole pine. Without fire, lodgepole pine may eventually be replaced by ponderosa pine, Douglas fir, Englemann spruce, cedar hemlock, or Englemann spruce/ subalpine fir stands. Lodgepole pine may persist as a climax species on sites too cold for Douglas fir or ponderosa pine, too dry for spruce fir, or too wet or infertile for other coniferous species (Wright and Bailey 1982).

The spruce fir forest type is dominated by Englemann spruce and subalpine fir. Limber pine and bristlecone pine are common associates on steep, rocky, and southern exposures. Douglas fir, aspen, lodgepole pine, blue spruce, and white bark pine are also found in this zone. These species often form dense stands with little herbaceous understory because of shading and considerable litter accumulation. Aspen generally becomes dominant after fire or other disturbance (Brown 1985).

Fire exclusion in any of these forest types adapted to high frequencies of understory fires can lead to accumulations of understory dead woody fuels, as well as the establishment of trees that provide fuel ladders between the surface fuels and the tree crowns, and it has substantially altered forest succession in some forest types (Barrett 1988, Stark 1977). Fire exclusion on forests with long stand replacement cycles results in increased fire hazard because flammability increases over much greater contiguous areas of forest and younger, less flammable stands are no longer present. For example, lodgepole pine stands that have had time to develop an understory of Englemann spruce and subalpine fir are much more flammable than before those species became established. Complete fire protection will allow less fire-tolerant species to replace more fire-tolerant species, as well as permit coniferous species to take over most sites presently dominated by aspen (DeByle et al. 1985).

Mature stands of juniper are frequently too open or contain insufficient herbaceous fuel to carry a fire (Lotan and Lyon 1981). However, burning can easily kill nonsprouting juniper, especially trees less than 4 feet tall (Dwyer and Pieper 1967). Larger trees require heavy amounts of fire fuel within their canopy coverage to crownkill (Jameson 1962). Where understories include sagebrush, large juniper trees can be killed by fire (Bruner and Klebenow 1978).

Postfire recovery of juniper after fire depends on seed reproduction and the rate of reinvasion depends on distance to seed source, the size of the burned area and the presence of dispersal agents. Junipers do not produce seed until they are about 20 to 30 years old.

Older trees are generally more fire resistant as bark thickens and the crown becomes more open, and may be able to survive low intensity fires. It is difficult to kill trees in fairly closed stands of juniper because there is little live or dead fuel on the surface, and a prescribed fire will not carry unless there are extremely high winds, a situation in which risk of fire escape is high. A treatment in juniper stands is to manually cut the trees, leave the slash scattered, wait several years for grasses and shrubs to recover, and then burn the site. This removes most of the dead fuel, greatly reduces the fire hazard, and kills any residual or newly germinated juniper trees. If a site is mechanically or manually treated only, it will probably have enhanced forage and browse production for about 20 years. Prescribed burning of the site about 3 to 5 years after treatment, once an understory has established, will maintain the productive character of the site for about 50 years (West 1979, as cited in Tiemenstein 1986b, Wright et al. 1979, as cited in McMurray 1986b). If high rates of forage utilization (which reduce fuels) and fire exclusion continue to be practiced on sites invaded by juniper, tree density will continue to increase, and juniper will continue to expand onto shrub- and grass-dominated sites (Burkhardt and Tisdale 1976). An active management program that includes prescribed fire will reduce the amount of tree encroachment and maintain the character and productivity of the original plant community.

Prescribed burning can be an effective management tool in forested vegetative communities in the West. Fire reduces surface fuels on clearcuts as well as in the understories of fire resistant trees; to remove understory reproduction in ponderosa pine, Douglas fir, and western larch forests, which provide a fuel ladder to the overstory; to thin overstocked stands of trees; to prune lower branches from trees; to create seedbed; to reduce vegetative competition with naturally regenerated or planted conifers; to enhance forage values; to maintain and improve browse quality and quantity; and to rejuvenate old stands of deciduous trees.

If fires are excluded from forest types which historically had high frequencies of understory fire, the eventual result can be the weakening of the stand, an increase in activity of bark beetles, and an increase in the proportion of dead trees. Fuels and/or bug-killed trees lead to stand-destroying fires. Many acres in the West have had fire excluded for 50 to 75 years, and some fires in recent years are likely a result of the accumulation of fuels and insect activity.

Slash from thinning and selective logging can be burned to reduce fire hazard without harming the residual trees in these communities. Ponderosa pine is generally not clearcut, but clearcuts in Douglas fir and western larch are often burned to manage the fuels, prepare seedbed and planting spots, and manage competing plants. Without fire, ponderosa pine and Douglas fir sometimes invade grasslands, and prescribed fire can be used to eliminate these trees when they are young.

Prescribed fire can produce favorable conditions for conifers. Burning ponderosa pine forests increases grasses and top-kills shrubs, such as chokecherry, western serviceberry, and bitterbrush, which will sprout the next year. In general, fire is beneficial to grasses and forbs in ponderosa pine associations but not where shrub understories dominate (Wright and Bailey 1982). Burning of Douglas fir forests increases shrubs such as snowbush, ceanothus. western serviceberry, common snowberry, and sticky currant. In some Douglas fir areas, ponderosa pine and quaking aspen may become fire climax species. Although easily killed by surface fires, quaking aspens quickly sprout from roots, making the tree a quick competitor in many Douglas fir and spruce fir forests.

The occurrence of fire in aspen stands has been reduced by fire suppression and by lack of understory fuels. The lack of understory herbaceous fuel caused by livestock grazing precludes the occurrence of fire in most aspen stands (Jones and DeByle 1985). Without fire, conifers invade many aspen stands, gradually eliminating the aspen, because aspen sucker replacement is often insufficient to replace overstory aspen mortality (Schier 1975). Aspen communities on sites not suited for conifer establishment may eventually be replaced by grasses and shrubs (Schier 1975). Suckering is prevented by the presence of mature trees as the trees and roots gradually deteriorate. Loss of aspen stands because of this phenomena has been observed in several Western States. A fire that occurs in an aspen stand that is still producing a few suckers, or in a mixed aspen conifer stand is likely to result in the rejuvenation of the aspen stand. The amount of postfire suckering is enhanced by warmer soil temperatures, which usually occur as a result of the blackened soil surface and reduced thickness of the litter and organic layer (Jones and DeByle 1985). As is true for rangeland sites, an aspen site must be rested from grazing until the community recovers to some degree (Brown and Simmerman 1985). Wildlife use can be regulated to some extent if a large enough burned area is selected, or if several areas in the same general vicinity are burned, thus dispersing use over a greater acreage.

The understories of ponderosa pine, Douglas fir and western larch communities are all adapted to fire. Some later successional species that may have established because of fire exclusion might not be favored, but the natural shrub, forb, and grass associates of these species would recover by sprouting or from seed stored in the forest soil organic layer (duff) after fire. The exact response varies by fire prescription, season, moisture condition, and plant species.

Slash burning potentially could do more harm to a site than prescribed underburning because of the presence of large amounts of slash on the soil surface. An objective for burning slash may be to kill some of the understory species so that less competition is present for trees that might be planted. Specific ranges of moisture content of large diameter fuels, duff, and soil can be selected for the fire prescription that will have the desired effect on understory vegetation, with consideration given to the effects of burning on the soil. One effect of this treatment, which is perhaps more closely associated with the removal of the forest overstory than of the burning itself, is that plants that require sunlight will do better after the treatment than those that require shade. This change in dominant species, or species present, would persist until the forest overstory again develops to the point where it provides a good cover of shade.

Riparian Areas: networks of riparian zones include perennial and intermittent stream channels, springs, seeps, bogs, etc. Riparian zones may be defined as the area within the active stream channel and floodplain combined with an adjacent zone of interaction between the channel and vegetation (in forested systems, generally the height of one site-potential tree). Within these distinct riparian networks, vegetative communities, soil types, moisture regimes, and subsequently, fire frequency and susceptibility, may differ markedly from the surrounding stands.

Riparian communities occur throughout Montana and the Dakotas, although they make up the least extensive vegetation type, with less than one percent of the total area and less than one percent of public land. Because of their productivity and other values, they are critically important and have received continuous intensive use since presettlement times (Branson 1985).

The presence of water, the increase in humidity, and the modification of temperature within riparian areas allow upland vegetation to exist at lower elevations than normal; riparian-related blue spruce is an excellent example. Riparian zones are also much more complex than their adjacent uplands (Thomas et al. 1979), making them much more difficult to categorize.

Conclusion: In the long term, many wildland fires would burn hotter and be more severe with Alternative A because there would be more fuels to burn during the hot dry periods when wildland fires are most common. Important native grasses would be more susceptible to damage from more wildland fire during hot dry weather. Shrubs are even less tolerant of fire than grasses. The season and intensity of wildland fires with Alternative A would generally cause the effects on shrubs to also be more severe with Alternative A.

With Alternative B, the use of more prescribed fire to treat hazardous fuels buildup would decrease less desirable species while increasing more desirable species on category B and C management areas. Long-term site productivity would be maintained and enhanced on more B and C category sites. Alternative B would increase edge effect and plant diversity at these sites. Important native grasses would benefit from more spring and fall prescribed fires. Mortality of many shrub species would be reduced compared to Alternative A because there would be more prescribed burning to reduce hazardous fuels when soils are moist. The use of more mechanical treatments and prescribed fires to reduce fuels and bug-killed trees with the proposed fire management would gradually reduce the potential and amount of stand-destroying wildland fires anticipated with Alternative A. Alternative B would result in more long-term improvements in overall forest health.

The treatments and cumulative effects on riparian areas would probably be about the same with both alternatives since the number and size of wildland fires and the use of prescribed fires would be similar.

Range Management: Burning of rangeland may temporarily reduce grass and forb production, thus reducing available forage for livestock. However, the burning of rangeland generally results in greater perennial grass production and grazing capacity as well as increased forage availability from the removal of physical obstructions to plants posed by dense stands of sagebrush or other brush species. Using prescribed burning in concern with herbicide treatments would effect the greatest positive response in situations involving brush land.

Some sagebrush communities are being invaded by juniper. Fire is a natural means by which the balance of these vegetative communities are maintained. Without disturbance such as fire, these communities tend to be invaded by woody species such as juniper. When this succession occurs, the amount of plant material that is available for grazing or browsing by domestic livestock or wildlife decreases.

Prescribed fires may be managed to increase the quality and quantity of forage. These fires create a balance of seral stages, open up more grassland parks, and reduce encroachment of juniper. Low to moderate intensity fires can have the objective to remove dense sagebrush stands and/or other species that herbaceous plants must compete with for sunlight, soil moisture, and nutrients. Prescribed fires also release nutrients back into the soil. The result is an “edge effect” and vigorous new plant growth which increase forage for grazing animals.

Burns can also improve range by distributing livestock and big game use. Fires help create a mosaic of vegetation that provides more palatable and nutritious forage. These burned area can also be effective in drawing cattle into uplands away from riparian areas.

However, since new growth that follows burns are favored by livestock and wildlife, there is the potential for excessive use which decreases plant vigor and increases erosion if grazing is not properly managed.

The immediate loss of forage and the effects of temporary use restrictions following fire would vary with the individual permittee, depending on the size of the area burned and the operator’s flexibility in his/her operation.

Conclusion: The immediate loss of forage and the effects of temporary use restrictions following wildland fires would occur with both alternatives. The severity of the fire may be less and recovery may be faster if the wildland fire burns an area recently treated with prescribed fire.

In untreated areas, competition from woody species in many grassland and shrub areas would continue to suppress grasses and forbes. The invasion of junipers and pines into herbaceous vegetation would continue in these areas and the quality and quantity of forage available for livestock would decline. This is more likely to continue with Alternative A than with the proposed management (Alternative B).

Range management and grazing permittees should benefit in the long term by the proposed fire management (Alternative B) which would increase the number of prescribed fires that are managed for increased forage production and accessibility for livestock and big game. The increased use of prescribed fires to improve range condition and increase forage production would allow operators more flexibility to plan for short-term disruptions in livestock grazing use.

Air

In undeveloped areas, ambient pollutant levels should be near or below measurable limits. Locations near economic developments and population centers are most vulnerable to air quality impacts such as automobile exhaust, residential wood smoke, and industrial pollution. Noise levels are site-specific and vary continuously. Rural noise levels should average 30 to 50 decibels A-weighted (dbA), with occasional peak levels to 90 dbA.

National ambient air quality standards limit the amount of specific pollutants allowed in the atmosphere: carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter (total suspended particulates and inhalable particulates).

Through the Clean Air Act Amendments of 1977, Congress established a system for the Prevention of Significant Deterioration (PSD) of “attainment” and “unclassified” areas. Areas are classified by the additional amounts of nitrogen dioxide (NO2), sulfur dioxide (SO2), and total suspended particulate (TSP) degradation that would be allowed. PSD Class I areas, predominantly National parks, Indian reservations, and certain Wilderness Areas, have the greatest limitations; virtually any degradation would be noticed. Areas where moderate controlled growth can take place have been designated as PSD Class II. PSD Class III areas allow the greatest degree of degradation.

PSD Class I regulations also address the potential for impacts to Air Quality Related Values (AQRVs). These AQRVs include visibility, odors, and impacts to flora, fauna, soils, water, and geologic and cultural structures. A possible source of impact to AQRVs is acid precipitation.

All BLM administered lands are classified PSD Class II. However several areas near BLM administered public lands are class I airsheds. These include Glacier National Park, Cabinet Mountain Wilderness, Flathead Indian Reservation, Mission Mountains Wilderness, Selway-Bitterroot Wilderness, Anaconda-Pintlar Wilderness, Gates of the Mountain Wilderness, Scapegoat Wilderness, Bob Marshall Wilderness, Medicine Lake National Wildlife Refuge, Fort Peck Indian Reservation, Fort Belknap Indian Reservation, U.L. Bend National Wildlife Refuge, Northern Cheyenne Indian Reservation, Yellowstone National Park, North Absaroka Wilderness, Washakie Wilderness, Red Rock Lakes Wilderness , Lostwood National Wildlife Refuge, Theodore Roosevelt National Park (North Unit, Elkhorn Ranch Unit, and South Unit), Wind Cave National Park, and Badlands National Park.

Areas that consistently violate federal standards because of human activities are classified as “non-attainment” areas and must implement a plan to reduce ambient concentrations below the maximum pollution standards. Non-attainment areas in Montana and the Dakotas include Great Falls, Columbia Falls, Flathead County (Whitefish and vicinity), Kalispell, Polson, Ronan, East Helena, Libby, Missoula, Lame Deer, Sanders County (Thompson Falls and vicinity), Butte, Billings, and Laurel.

Fires are a source of air pollutant emissions because of the combustion which burns various ages, sizes, and types of vegetation. The amount of emissions depends on the size and intensity of the fire, the fuel type and moisture content, and the available fuel loading. The most effective means of controlling air pollutant emissions from wildland fire is to inhibit large, catastrophic fires through vegetation treatments that break up heavy, continuous fuels. Depending on the conditions, managed natural fires and prescribed fires can be effective methods to reduce heavy fuels. When properly executed, managed fires are expected to result in fewer short-term and long-term air quality impacts. These managed fires are normally much smaller and involve less combustion since they occur when fuel type and fuel loading meet preset parameters for control and under weather conditions that enhance efficient fuel consumption and air pollutant dispersion. By reducing the risk of uncontrolled wildland fire, the risk of significant air quality impacts is also reduced.

Other impacts to air quality would include moderate increases in noise, dust, and combustion engine exhaust generated by manual and mechanical treatment methods; and aerial application of retardant. Impacts would be temporary, small in scale, and quickly dispersed. These factors, combined with standard management practices (resource considerations included in Appendix A) minimize the significance of potential impacts. Federal, State, and local air quality regulations would not be violated.

Potential air quality impacts are assessed before project implementation. Site-specific plans are reviewed for compliance with applicable laws and policies, and existing air quality is inventoried so that changes associated with the BLM proposals may be determined. Additional mitigation may be incorporated into specific project proposals to further reduce potential impacts. For example, prescribed burning activities must comply with the BLM Manual, Sections 9211.31(E), Fire Planning, and 9214.33, Prescribed Fire Management, to minimize air quality impacts from resulting smoke. This procedure requires compliance with individual state and local smoke management programs that specify the conditions under which burning may be conducted.

Particulate matter and carbon monoxide are the primary pollutants emitted during prescribed burning that would affect air quality. Compliance with local smoke management programs would minimize these effects. The timing, vegetation type, size of burns, fuel arrangement and moisture, ignition techniques and patterns, and weather conditions are all specified to keep smoke amounts within acceptable limits. The actual level of impact depends on a combination of all these factors. Prescribed burning would generally occur under more favorable air conditions to meet air quality regulations since the exact timing and location of wildland fires cannot be controlled.

Potential cumulative impacts may occur when multiple fires occur simultaneously or if fires occur when other nonfire related activities are also contributing to air quality impacts. If conditions were such that the cumulative effects of human activities violated air quality standards in Class I airsheds, prescribed burns would not be allowed until conditions change and prescribed burns could occur without exceeding air quality standards.

Smoke impacts and smoke management of prescribed fires are coordinated regionally by the Montana/Idaho Executive Airshed Board with members from federal and state agencies and private industry.

Conclusion: Overall, air quality impacts would generally be greater with wildland fires than with prescribed fires since wildland fires burn more acres and are less likely to occur under favorable conditions. Since more wildland fire are expected to burn more area and under less favorable conditions with Alternative A, air quality impacts are also expected to be greater even though Alternative B would have more prescribed fires. The severity of cumulative air quality impacts from multiple wildland fires that occur simultaneously and burn more acres and consume a greater proportion of fuel would be greater with Alternative A. Guidelines contained in Appendix A would also help reduce the impacts from the Proposed Action (Alternative B).

Soils

Soils are variable across Montana and the Dakotas and have different characteristics and different properties depending on such factors as climate, vegetation, and parent material. Soil types that occur on BLM lands are identified in most of the BLM Resource Management Plans.

Results from studies of wildland fires are difficult to interpret because of the widely varying environmental conditions under which they occur and the fact that these conditions are rarely documented.

Fireline construction exposes soils to accelerated soil loss, invasive species, reduced site productivity, concentrated overland flow, sediment delivery to streams, water quality degradation, and aquatic habitat problems. Without proper precautions, fueling sites and retardant drops may result in contamination of surface water, ground water, and soils. Soil and vegetation damage may result from the construction and use of new camp sites, staging areas, and helibases. Damming culverts for water sites can saturate road embankments and cause mass failure or force overbank diversion which can cause erosion. Excavating pools can cause stream destabilization and increased sedimentation. Constructing streamside engine access can damage riparian vegetation and soils.

Prescribed burning affects soils primarily by consuming litter; organic soil layers; down, dead, and woody fuels; and vegetative cover (Wright and Bailey 1982). Fire may alter soil chemical properties, nutrient availability, postfire soil temperature, microorganism populations and their activity rates, physical properties, wettability, and erosion. The degree to which these characteristics are affected in the short term depends on the ignition technique used; dead fuel, live fuel, organic layer, and soil moisture at the time of burning; thickness and packing of the litter layers; depth and duration of heat penetration into organic and soil layers, as well as maximum temperature attained at different depths within the profile; soil type; and soil texture.

Nutrient losses from the site and postfire erosion are closely related to topography, remaining plant cover, frequency and area of bare soils, and the timing and severity of postfire precipitation events with respect to postfire litterfall and vegetative recovery. A significant storm can wash ash from the surface, removing many of the nutrients released in the ash. Gentle rains can carry some of these nutrients into the soil profile. Many of the nutrients released in ash can be taken up by rapidly growing vegetation. Net nutrient losses caused by consumption of organic matter may be counterbalanced by increased availability of nutrients formerly locked in complex organic forms that cannot be used by plants. Activity of decomposing and nitrogen-fixing organisms may also change, further affecting the postfire nutrient balance.

Changes in soil chemical properties, including soil nutrients, caused by burning usually include an increase in soluble nitrogen, phosphorus, potassium, sulfur, magnesium, sodium, and calcium, and an increase in soil pH, which means a decrease in soil acidity (Fuller et al. 1955, Summerfield 1976). Carbon-nitrogen ratios are reduced because of the nitrogen increase and subsequent carbon decline caused by burning (Fuller et al. 1955). Losses of nitrogen and sulfur from mineral soils can occur as a result of volatilization, but conflicting results have been reported (Wright and Bailey 1982). Very severe (high-heat) fires usually result in net soil losses of nitrogen, calcium, and magnesium (Stark 1977, DeBano and Conrad 1978). Infiltration and percolation of water also may leach these nutrients in addition to raising the pH of the soil, altering soil chemistry, and changing ground-water and surface-water quality. Soil cation-exchange capacity also may decrease after severe burns (Wright and Bailey 1982).

The percentage of nitrifying bacteria in soil that are killed depends on the depth and duration of soil heating, which varies significantly among fires. This is true for any group of soil microorganisms. Microorganism populations decline immediately after a burn (Jurgensen et al. 1979) but can quickly recover to greater than preburn numbers (Wright and Bailey 1980). Nitrifying bacteria, however, are extremely sensitive to fire over wet and dry soil and do not recover quickly after a burn (Dunn and DeBano 1977). The threshold temperature level is lower in wet soil than in dry soil, and the amount of soil heating is generally regulated through the prescription in the prescribed fire plan. Heterotrophic bacteria respond to heating in a similar manner as nitrifying bacteria, but at higher temperatures (Dunn and DeBano 1977). Fungal responses to burning are not consistent (Ahlgren and Ahlgren 1965). However, when related to metabolic processes, microbial populations are not adversely affected by prescribed burning (Wright and Bollen 1961, Jorgensen and Hodges 1971, Summerfield 1976).

The effect of fire on soils is closely related to the burn severity and the heat pulse to the soil, which is the result of the combustion of all fuels during flaming, glowing, and smoldering combustion. Significant amounts of deep soil heating occur only if there is long-duration burning in thick organic layers or accumulations of dead woody debris. Moisture content of thick organic layers, large-diameter dead fuels, and soil are critical determinants of the depth of heat penetration because wet fuels do not burn and moist soils limit the depth of soil heating (Frandsen and Ryan 1986). There is a close relationship between fire line intensity (the rate of heat released per foot of fire line during flaming combustion) and flame length. However, there is little relationship between the heat released during flaming combustion and soil heating. Most of the heat from flames rises and does not heat the soil. A high intensity fire with long flame lengths will cause little soil heating except at the immediate surface if subsurface fuels and soils are moist.

Studies generally agree that prescribed burning causes no appreciable change in soil mineral fractions (Beaton 1959, Summerfield 1976), although the heat of very severe fires may render a soil structureless and alter porosity and infiltration rates (Ralston and Hatchell 1971). However, a fire this severe is not likely to be staged in the vegetation types under prescribed conditions. Measurable changes in aggregation and permeability in soil surface layers also have been reported (Scott and Burgy 1956). Soil aggregate stability is maintained by vegetation cover protection (Tate 1987).

Depending on the severity and duration of a fire, some moderately permeable soils may develop resistance to wetting through the distillation of organic compounds (Wells et al. 1979, Wright and Bailey 1982, Holechek et al. 1989). Water-repellent layers are most common in shrub communities on dry, sandy soils (DeBano et al. 1976), but also occur in forest soils (Zwolinski and Ehrenreich 1967).

Vegetative cover, in addition to supplying organic material to the soil, also provides a structural shield to the ground surface. Removal of vegetation and litter exposes mineral soil and subjects the surface to raindrop impact, increasing overland flow and subsequent soil loss (Wright and Bailey 1982, Holechek et al. 1989). Soil creep and debris flow also can occur after soil is exposed (Wright and Bailey 1982).

The most important factors determining whether significant amounts of postfire erosion will occur are the amount of residual vegetation and organic matter remaining, the rate and amount of vegetative recovery, the timing of the vegetative recovery with respect to season and severity of precipitation events, and slope. In forested sites, litterfall of scorched conifer needles can significantly cover the soil. When planning a prescribed fire on erodible soils, these effects can be mitigated by prescribing the fuel and organic layer moisture, thus minimizing the amount of organic layer removal; timing the fire so that vegetative recovery begins soon after; and leaving unburned areas of vegetation.

A Streamside Management Zone (SMZ) should be maintained around riparian, streamside, lakeside, or wetland areas. SMZs are buffer zones extending a minimum of 50 feet from the edges of these waterbodies to provide a vegetation filter that will remove sediment before runoff reaches waterbodies. Wider SMZs should be maintained where necessary in areas of steep or highly erodible soils to aid in soil and streambank stabilization and decrease the amount of sediment that reaches waterbodies (Montana State University, 1991).

Most chemical and soils effects in sagebrush are limited to the areas beneath sagebrush plants where most of the litter has been consumed because these are the only areas where high enough temperatures are generated to cause heating of associated soils to any significant depth. The major concern when burning is the postfire possibility of wind and water erosion (Summerfield 1976). The likelihood of erosion increases with slope and the length of time that the area remains sparsely vegetated. Wind erosion of topsoil is likely on exposed areas. For this reason, treatment planning should consider the timing of the burn with regard to the growing period of native vegetation and the time when any planted species might germinate and grow, as well as the seasonal occurrence of high winds or major precipitation events. Most soils in the sagebrush-grass areas are derived from basalt, and soil texture varies from loamy to clayey, although extensive areas have soils derived from rhyolite, loess, lacustrine, alluvium and limestone (Wright et al. 1979).

In general, studies of prescribed burning on sagebrush sites indicate that organic matter, pH, and nitrogen may be increased in soil surface layers (Summerfield 1976), but Blaisdell (1953) reported no pH change after sagebrush-grass burning. Burning sagebrush and leaf mulch may produce water repellency in soils under sagebrush plants (Salik et al. 1973). Although burning while the soil and mulch are cool and damp will reduce or eliminate this potential (Salik et al. 1973), pure stands of sagebrush may burn extremely hot (Wright and Bailey 1982).

Soil properties affected by burning on juniper communities include reduced infiltration rates (Buckhouse and Gifford 1976a) and increased amounts of phosphorus, potassium, nitrogen, and carbon for the first year following debris pile burns (Gifford 1981). Overland flow from burned areas contained greater amounts of potassium and phosphorus than from unburned areas (Buckhouse and Gifford 1976b). Broadcast burning of chained and/or manually cut juniper is the best way to manage the site to prevent rapid takeover by small residual surviving juniper.

Burning juniper slash piles may be detrimental in some situations because soils may be sterilized by the concentrated heat, resulting in nutrient losses and declines in watershed quality (Everett and Clary 1985); however, in some cases, burning may be the only safe way to remove the slash piles. Leaving juniper slash material in place, rather than concentrating slash in piles, will reduce the potential for adverse impacts to the soils caused by localization of soil heating beneath fuel piles, as well as limit additional soil compaction caused by machinery used to pile or windrow the debris. Slash material burned in this fashion also releases nutrients such as nitrogen and phosphorous to the soil for immediate seedling uptake. Prescribed burning of a site several years after trees are chained or manually cut increases the length of the effective treatment because it kills residual trees or newly established tree seedlings. Additionally, the burning of windrowed slash eliminates visual conflicts, reduces survival of young or rooted juniper trees, and may increase seeding survival and establishment by eliminating habitat for rodents and rabbits. Removal of shrubs and trees from juniper communities by fire generally does not affect erosion. The treatment of shrubs and trees in juniper communities by prescribed burning, in conjunction with good management practices, should not significantly affect the rate of soil erosion. Burning of cabled or manually cut juniper three years post-treatment reduced the fire hazard and killed residual trees and new juniper seedlings in central Oregon and also resulted in decreased erosion because of the release of existing understory plants and establishment of new plants, which caused a significant increase in protective vegetative cover over the watershed in comparison to the unburned area (Lent 1989).

Burning in plains grassland communities is a common practice. The removal of litter and soil organic matter has similar effects on soil aggregation and infiltration. Excessive litter accumulations may reduce microorganism activity (Wright and Bailey 1982) and nitrification; nitrogen-fixation and ammonification are increased by pH and the increased concentration of electrolytes after burning. Soil losses after burning on grasslands should be minimal because the grassland sod root systems and rhizomes remain in place, thereby facilitating rapid vegetation recovery and limiting the possibility of erosion.

Severe (high-temperature) burns on dry sites may form a water-repellent layer in the soil (USDA 1988). This direct impact to soil infiltration rates typically is avoided with prescribed burns by the burn prescription (program design), which evaluates the various parameters that control the burn conditions (fuel loading, fuel moisture content, and soil moisture conditions) and authorizes the burn to proceed only when field conditions are conducive for a successful and effective burn.

The effect of burning on forest soils is closely related to fire severities (temperatures). Burning consumes organic matter on top of the soil and may consume some of that in the soil surface (Fowells and Stephenson 1933), although prescribed burning can be conducted to minimize duff removal (Fuller et al. 1955) and heat penetration into soil. Organic matter reduction is correlated to the reduction in total nitrogen on the forest floor; however, nitrogen accumulation occurs in the 0-to-2-inch soil layer (Wells et al. 1979). Phosphorous, potassium, calcium, and magnesium may increase in the 0-to-2-inch layer of forest soils post-burn (Wells et al. 1979), although Cambell et al. (1977) reported lower potassium levels in soil of burned areas than in unburned control plots. Prescribed burning apparently does not alter soil microorganism populations to the extent that soil metabolic processes would be impaired (Jorgensen and Hodges 1971); rather, the increase of soil temperatures could enhance soil metabolic processes by causing increased rates of nutrient cycling and increased nitrogen availability because of greater activity of decomposing and nitrogen-fixing bacteria.

Severe burning generally occurs only when levels of moisture in fuel, duff, and soil are low. In most cases prescribed fire would not be done under these circumstances. The main influence of severe burning on forest soil physical properties is to decrease soil permeability to water; light burning only slightly affects the physical soil properties (Fuller et al. 1955). If consumption of heavy fuels such as forest slash occurs, fires may decrease soil aggregates and porosity and increase bulk density for up to four years (Holechek et al. 1989). Also, some forest soils may develop a temporary resistance to wetting (Holechek et al. 1989), on sites where soil heating was concentrated beneath burning accumulations of heavy fuels. Temporary increases in overland water flow and erosion may result where severe fires denude soil cover and change soil physical properties (Hendricks and Johnson undated, Holechek et al. 1989). The gravity-induced movement of soil particles, can increase after a fire, with the amount related to the steepness of slope, the amount of vegetative and organic cover remaining, and the rate of vegetation recovery. However, these effects can be mitigated on prescribed burns by burning forested areas under moisture regimes that ensure the maintenance of residual organic cover and/or result in fairly rapid vegetative recovery.

Conclusion: The number of acres burned by wildland fires, the intensity of these fires, and the acres needing rehabilitation, would gradually decrease with Alternative B mostly on category B and C fire management zones. More equipment restriction and the use of “light-on-the-land” suppression practices to protect steep and fragile soils with Alternative B (see Appendix A) would also avoid or reduce impacts to soils. In the long-term, the effects on soils from wildland fire described above would be less with Alternative B than with Alternative A (No Action).

With Alternative B, the number and total acres treated with prescribed fires and the number of mechanical treatments and acres treated to reduce hazardous fuels would increase compared to Alternative A. Guidance provided for prescribed fires in Appendix A would help mitigate adverse impacts. Anticipated impacts described above from prescribed fires would eventually be offset by reduced impacts from wildland fires.

Water Quality and Quantity

By burning vegetation and ground litter, fires reduce or eliminate the vegetation cover that buffers precipitation before it hits the soil surface. As a result, burned sites have lower soil-water infiltration rates which results in increased surface runoff and decreased soil moisture available for plants. Increased runoff can stress the stability of receiving streams and the associated aquatic biota. The seasonal timing, size, duration, and intensity of the fire determine the magnitude of these impacts.

Intense wildland fires cause greater increases in water temperature, sedimentation, and turbidity in the water by burning off vegetative cover, exposing mineral soil, and promoting surface runoff. Accelerated erosion also increases with surface disturbing fire suppression activities such as the use of heavy equipment to blade fire lines and off road vehicle use. Sediment from accelerated soil erosion and elevated levels of nitrogen and phosphorous from ash are common in water after wildfires. Most water quality impacts related to wildland fire depend on the type of vegetation burned and how long the vegetation is depleted. Often these impacts are short term and conditions return to pre-fire levels once vegetation is re-established. Increases in water temperature are typically caused by removing overhead shading.

Prescribed fire may increase stream nutrients, storm flows, and sediment loads. In general, the amount of increase depends on fire severity. Slash burns may produce minor increases in concentrations of some nitrogen compounds and cations; however, drinking water standards should not be exceeded even by severe burns. Underburns and grassland burns would have no significant effect on nutrients. Moderate slash burns may increase storm flow volumes and peaks to streams by reducing the water used by remaining vegetation. Severe burns would cause greater increases by exposing mineral soil and promoting surface runoff. Underburns and grassland burns would be light to moderate. Underburns would not affect water quality, and grassland burns would affect it for only a few weeks until grass regrows. These burns would not significantly affect stream flows.

Invading juniper often compete with understory vegetation and cause its decline or loss. Resulting bare soils are subject to erosion. These trees use much more moisture than shrubs, forbs, and grasses. Prescribed fire that removes trees results in increased water yield, rejuvenates springs, allows understory to recover, and provides more watershed protection.

In order to protect water quality and TES, Special Status, and sport fish habitat, a Streamside Management Zone (SMZ) should be maintained around riparian, streamside, lakeside, and wetland areas. This 50-foot (minimum) buffer zone helps preserve a variety of ecological processes by creating a vegetation filter that removes sediment before it reaches a waterbody. Properly maintained SMZs protect trout fry and other young fish; maintain water temperatures necessary for spawning; introduce insects and other fish food to the water from streamside vegetation; stabilize streambanks and floodplains; and protect bird habitat and wildlife travel corridors associated with riparian areas. To minimize erosion and the amount of sediment that reaches waterways, special care should be given to maintaining an SMZ of appropriate width.

Conclusion: There is a greater expectation of water quality and quantity impacts (increased water temperature, sedimentation, and turbidity) from Alternative A because of a greater long-term likelihood of severe wildland fire, especially on forest lands in areas of hazardous fuels buildup. Wildfires in these areas burn hotter and are more likely to also burn riparian areas that protect stream and ponds.

With Alternative B, the number and total acres treated with prescribed fires and the number of mechanical treatments and acres treated to reduce hazardous fuels would increase compared to Alternative A. Guidance provided for mechanical treatments and prescribed fires in Appendix A would help mitigate water quality and quantity impacts.

Fish and Wildlife

Aquatic species trout native to Western Montana (such as bull and westslope cutthroat trout) evolved in a dynamic environment. Wildfires, ranging from small under-burns to large, stand-replacing events, were a natural part of this environment, as were the stochastic events such as landslides that commonly followed. This historic fire regime is characteristic of a “pulse” disturbance pattern, in which events occur at one time with no further direct effects to the environment. It is likely that drainage-scale extirpations of fishes followed large-scale, intense wildfires; however, regional populations were strong enough to provide individuals to quickly recolonize impacted areas.

Fish species most likely to be affected by the fires themselves are resident fishes of smaller streams: resident bull trout, westslope cutthroat trout, and sculpins. Resident fishes are entirely dependent on available habitat and stochastic events such as fires have been identified as a threat to these small, resident populations (Rieman and Macintyre 1993). In contrast, migratory fishes with access to larger streams (such as fluvial bull and westslope cutthroat trout) are more resilient to these environmental effects.

The disturbance cycles under which fishes evolved have changed substantially. Current patterns could be better described as a chronic or “press” pattern, with continual, direct effects to the aquatic environment and associated fish species. As a result, the capacity of fishes to withstand both the direct and indirect effects of wildfire has substantially diminished. Fishes already physiologically stressed are substantially less able to survive the additional increases in water temperature, inputs of fine sediments, or changes to hydrologic regimes that may follow wildfires. Furthermore, populations of native fishes are substantially reduced from historic levels, resulting in fewer “expendable” individuals and less fishes available to replenish populations elsewhere. Re-colonization may also be hampered by barriers to migration, including culverts, roads, and dams.

Thus, although wildfire and its direct and indirect effects are natural factors the in aquatic and riparian ecosystems, the diminished physiological capacity of regional fishes, lack of available refugia, and low numbers of individuals available for post-fire re-colonization of burned drainages warrants an extremely cautious approach to fire management within these sensitive areas.

Any change in the vegetation of a particular plant community is likely to affect the wildlife species associated with that community. Any change in community vegetation structure or composition is likely to be favorable to certain animal species and unfavorable to others (Maser and Thomas 1983). The key to understanding the effects of vegetation manipulation on wildlife involves an understanding of the vegetation structure, production, flowering, and fruiting of the community; these characteristics relate to seasonal cover and food requirements for particular animal species and predators dependent on them. These characteristics also respond to a particular vegetation manipulation.

Plant communities on many western rangelands are no longer pristine and therefore do not support pristine populations of wildlife species. Many range land plant communities have herbaceous weeds or a higher ratio of woody to herbaceous perennial vegetation than under pristine conditions. These vegetation conditions may favor certain wildlife species, such as the chukar partridge which utilize cheatgrass for food (Weaver and Haskell 1967), or they may disfavor other species, such as the pronghorn antelope, which require mixed-plant communities, rather than those plant communities dominated by a few woody or herbaceous species (Yoakum 1975). In general, the greater the diversity of the plant community, the greater the diversity of the associated animal community (Gysel and Lyon 1980).

Therefore, any change in vegetation community structure or composition will affect resident fish and wildlife populations. The effects of fire on wildlife depend on the effects to vegetative structure, production, and phenology of the community. These characteristics relate to seasonal cover and food requirements for particular animal species--and the predators that depend on them. Effects on fish and wildlife from fire management depend on the timing, intensity, and vegetative species burned. Treatments that reduce runoff and sedimentation would benefit fish and aquatic wildlife. Treatments that cause shifts or changes in forage and habitat for wildlife, may have beneficial or negative effects, depending on the species.

Some prescribed fires have an objective of modifying some aspect of the vegetation for wildlife. These may change forage quality and quantity, intersperse new feeding areas with areas providing cover, and/or rejuvenate decadent browse plants. Changes in vegetation structure and dispersion of burned areas are key factors when planning prescribed fires for wildlife purposes.

Many different wildlife (vertebrate) responses to fires have been reported. Fire effects on wildlife vary with (1) animal species complex, (2) mosaic of habitat types, (3) size and shape of fire-created mosaic, (4) fire intensity, (5) fire duration, (6) fire frequency, (7) fire location, (8) fire shape, (9) fire extent, (10) season of burn, (11) rate of vegetation recovery, (12) species that recover, (13) change in vegetation structure, (14) fuels, (15) sites, and (16) soils. In addition, all the other factors that alter fire effects on vegetation and soils will influence wildlife responses to burning.

In general, fire affects wildlife by directly killing birds and animals, altering immediate post fire environments, and influencing postfire habitat succession (Lyon et al. 1978). Killing vertebrates by prescribed burning is rare (Lyon et al. 1978). For those species that cannot flee a burn, the most exposed habitat sites are dry, exposed slopes, hollow logs with a lot of exposed wood, burrows less than 5 inches deep, lower branches of trees and shrubs, and poorly insulated underground/ground nesting areas (Lawrence 1966, as cited by Peek 1986). Effects of prescribed burning on ground cover depends on fire severity: less severe fires on wet sites would remove less cover than more severe fires on dry sites. Escaped prescribed burns may accidentally destroy riparian habitats and impact aquatic resources, causing losses of wildlife through exposure, total loss of habitat, and through increased sedimentation of aquatic habitat caused by unchecked overland flow and destabilized stream channels.

Fire mainly affects wildlife through habitat alteration (Wright 1974a). Fire may create habitat diversity, by recreating lost or degraded habitats for indigenous species, and by allowing for the reintroduction of extirpated species when habitat degradation was significant to their extinction. Immediate postfire conditions raise light penetration and temperatures on and immediately above and below soil surfaces and can reduce soil moisture (Lyon et al. 1978). Burning of cover and destruction of trees, shrubs, and forage modify habitat structure (Lyon et al. 1978, Peek 1986). The loss of small ground cover and charring of larger branches and logs (with diameters greater than 3 inches) can affect small animals and birds. Early, vigorous vegetation growth immediately after a fire alters feeding and nesting behaviors (Lyon et al. 1978). Postfire plant and animal succession effects creating seral and climax mosaics in habitat cannot be generalized in their effects on wildlife (Lyon et al. 1978, Peek 1986). Impacts can be lessened if the period of treatment avoids the bird nesting season and other critical seasons when loss of cover would be critical to wildlife; for example, during critical reproductive periods and prior to severe winter weather conditions.

No significant changes in small mammal species were observed for one year postburn in sagebrush-grassland (Frenzel 1979, as cited by Starkey 1985), but shrews and other species with narrow niches require patches of unburned vegetation to sustain populations, although total small mammal numbers may not be altered (McGee 1982). Habitat changes induced by fire may temporarily decrease the number and diversity of small mammals in sagebrush vegetation (Klebenow and Beall 1977). By increasing habitat diversity, associated bird communities may be increased by burning (Starkey 1985). Low fire frequencies may be useful in maintaining productive habitat for sage grouse (Peek 1986). Large intense fires affect other bird species, such as yellowthroat, yellow-breasted chat, Traill's fly-catcher, and yellow-billed cuckoo, because they require dense shrub cover (McAdoo and Klebenow 1978). Conversely, sparrow species require relatively less shrub cover (McAdoo and Klebenow 1978). Because chuckar partridge rely heavily on cheatgrass, fire could conceivably be used to improve the habitat for this species (Wright and Bailey 1982). Prescribed burning in these types also may improve the habitat for higher numbers of sheep, pronghorn antelope, and mule deer (Klebenow 1985). Fire suppression has favored the expansion of mule deer populations in some sagebrush areas because of the increased forage or cover (Crouch 1974). In areas of limited rainfall and forage production the thermal cover provided by sagebrush may be critical to deer and other wildlife survival (W. A. Molini, pers. comm. 1990). Big sagebrush is a valuable forage plant on critical deer winter range and should be protected from fire in these areas (Vallentine 1980).

While complete type conversion of juniper sites to grassland may reduce wildlife diversity, creating a mosaic of successional stages with prescribed burning can be beneficial to wildlife (Severson and Medina 1984). Spotty burning probably would favor the greatest diversity of rodent and bird species (Wright and Bailey 1982). Fire suppression has favored expansion of mule deer populations in some juniper areas because of the increased forage or cover. Deer and elk use of burned juniper areas depends on postfire successional stages (Stager and Klebenow 1987), because burning can eliminate some important deer browse species (McCulloch 1969). An important factor in the degree of use of burned juniper habitats by deer and elk is the interspersion of burned habitats, which provide food, and unburned sites, which provide thermal and hiding cover. Old growth juniper stands may offer unique and valuable wildlife habitats, adding to the variety within juniper stands. When planning site-specific treatments, it should be recommended that these old growth communities be left standing as islands and edge communities to the prescribed burning areas.

Fire can be used to improve some species of prairie wildlife. Dabbling ducks and sharp-tailed grouse production increased on burned grassland as compared to undisturbed grassland in North Dakota (Kirsch and Kruse 1972). Prescribed burning also improved upland plover production. Fires can be destructive to songbirds, which require shrubs for nesting (Renwald 1977). Periodic burning is desirable to maintain ideal prairie chicken habitat in tallgrass prairie, but burned areas may not be preferred habitat for sharp-tailed grouse for several years postfire (Wright and Bailey 1982).

According to Marco Restani (Evaluating Management Strategies to Improve Prairie Dog Habitat in Eastern Montana: A 10-Year Plan, Draft, 1999), "The role of fire in limiting or promoting prairie dog populations is unknown. Fire alters grassland habitat, primarily by reducing shrub cover (Samson and Knoph). Reduced shrub cover could enhance areas for prairie dogs (Player and Urness, 1982), but the loss of sagebrush habitat and the threat of exotic grass introduction appear to make fire an undesirable tool for prairie dog habitat management."

Fire effects on wildlife in coniferous forests depend on ecological relationships and animal habitat needs. Ground fires have little direct influence on tree squirrels and may even be favorable by perpetuating ponderosa pine communities (Wright and Bailey 1982). Ground squirrels initially decreased in burned ponderosa pine communities but increased later as early successional advances were made (Lowe et al. 1978). Fire would probably adversely affect chipmunks in those communities where drier conditions prevail, but they may increase postburn on more moist sites (Lowe et al. 1978, Wright and Bailey 1982). Total bird numbers increased initially after burning in ponderosa pine communities but fell to below prefire levels later, although some individual species responded in an opposite manner (Lowe et al. 1978).

In one study, both deer and elk decreased their use of areas immediately following a burn but quickly increased levels of use as compared to control plots. Benefits to deer and elk from fires in these types are generally related to increases in understory vegetation (Leege and Hickey 1971, Severson and Medina 1983). Burns in Douglas fir and ponderosa pine communities improved forage palatability to mule deer (Keay and Peek 1980). Prescribed fire also can improve winter forage for mountain sheep (Hobbs and Sporwart 1984). Prescribed fire can be used to rejuvenate old aspen stands, increasing habitat for moose, elk, deer, ruffed grouse, and snowshoe hare, all of which depend on the forage or cover produced in a young aspen community (DeByle 1985).

Conclusion: At first, comparing Alternative A to Alternative B involves comparing effects of wildland fire on wildlife to the effects of prescribed burning on wildlife. While some vertebrates are killed directly by fire, it is rare to kill vertebrates by prescribed burns. The other major effects of fire on wildlife, altering immediate postfire environments and influencing postfire habitat succession, would be determined as rehabilitation with wildland fire but could be considered as part of prescribed burning activity. Additionally, Alternative B would involve the selective introduction of fire to certain habitats and could be avoided in areas or at times where fire is not desired (i.e. in the immediate vicinity of sage grouse leks during nesting season). Eventually, implementation of prescribed fire (Alternative B) would reduce the likelihood of wildland fire and the associated impacts on wildlife.

Threatened, Endangered, and BLM Sensitive Species: The following tables (9 and 10) summarize the presence/absence of Threatened, Endangered, and BLM Sensitive species and/or their habitat. The tables also provide recommended guidance for minimizing effects of prescribed burning and other fuel reduction activities under Alternative B.

The range and habitat presence are summarized by Field Office in tables 9 and 10, which are represented by the following codes:

010–Billings	064–Havre
020–Miles City	070–Butte
030–North Dakota	090–Malta
040–South Dakota	092–Glasgow
050–Dillon	100–Missoula
060–Lewistown	

The tables also summarize appropriate fire suppression methods for the species present in each Field Office, as represented by the following coding:

Wildland Fire Suppression:.

Specific guidance for minimizing effects:

WF1 - Protect known locations of occupied habitat**.**

WF2 - Avoid use of heavy equipment (bulldozers, engines) within 100 meters of occupied habitat except as necessary to protect reproductive sites (nests, dens, etc.).

WF3 - Restrict the use of aerial retardant application within 100 meters of occupied habitat except as necessary to protect reproductive sites (nests, dens, etc.).

WF4 - Restrict the placement of fire camps, fire staging areas, and helibase from within 1/4 mile of occupied habitat.

WF5 - Use of motorized vehicles during mop-up activity in suitable or occupied habitat should be avoided.

WF6 - Restrict helicopter bucket fills, engine/pumper fills, or other water access/uses from within 100 meter of unvegetated sand-pebble beaches or islands in freshwater and saline wetlands and shorelines and exposed beds of larger reservoirs and rivers.

WF7 - Restrict the use of heavy equipment, fire retardant, or placement of fire camps, staging areas, and helibases from within any occupied drainage.

Rehabilitation: General - Rehabilitation plans shall be designed and associated NEPA documentation (environmental assessment) shall disclose how the proposed action will maintain or improve the quantity and quality of suitable habitat for TES species.

Specific guidance for minimizing effects:

RH1 - Timing of rehabilitation efforts shall avoid disturbance during the reproductive (nesting, denning) season of TES species (varies by species).

RH2 - Avoid and protect all known nesting, roosting, denning, and spawning sites/structures and maintain adequate patch size of habitat around site/structure.

RH3 - No rehabilitation activities shall be incurred within 100 meters of sensitive plant populations unless specifically designed to maintain or improve the existing population.

RH4 - Use of non-native vegetative species shall be minimized.

RH5 - Off road use of motorized vehicles in suitable or occupied habitat should be avoided.

Fuels Treatments (Prescribed Burning and Other Fuels Management):

General - Prescribed Burn/Fuels Reduction plans shall be designed and associated NEPA documentation (environmental assessment) shall disclose how the proposed action will maintain or improve the quantity and quality of suitable habitat for TES species.

Specific guidance for minimizing effects:

FT1 - Timing of prescribed burning or other fuels treatment activities shall avoid disturbance during the reproductive season of TES species (varies by species).

FT2 - Avoid and protect all known nesting, roosting, denning, and spawning sites/structures and maintain adequate patch size of habitat around site/structure.

FT3 - No prescribed burning or other fuels treatment activities shall be incurred within 100 meters of sensitive plant populations unless specifically designed to maintain or improve the existing population.

FT4 - Baseline information shall be collected pre-treatment on existing condition and post treatment monitoring shall be conducted to determine the effectiveness of project.

FT5 **-** Avoid off road use of motorized vehicles during prescribed burn or other fuels treatment activities in suitable or occupied habitat.

FT6 - Insure fire prescription or fuels treatments will not consume dominate (large) trees within 1 mile of known nests and roost sites.

FT7 - Avoid and protect important use areas for individual species; i.e. travel corridors (grizzly, lynx, wolf), resting sites (forested riparian for grizzly), foraging areas (snowshoe hare habitat for lynx), rendezvous sites (wolves).

TABLE 9
FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES AND SPECIES PROPOSED FOR LISTING

Species (Status) (E) Endangered (T) Threatened (P) Proposed	Field Offices/Stations In Range (R) and with Habitat Present (H)	Field Offices with documented occurrence	Guidance for fire suppression, rehabilitation, prescribed burning, and other fuel reduction efforts. See Appendix A.
Bald Eagle (E)	R - all H - all	MT- 010, 020,030,040, 050,064, 070, 092,100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5, FT6
Least tern (interior population) (E)	R- MT 010, 020, 030, 040, 060, 064, 090, 092 H-MT 010, 020, 060, 064, 090,092	MT 030,040	WF5, RH5, FT4, FT5, If presence of the species is documented the following guidance will apply: WF1, WF2, WF3, WF4, WF5, WF6, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Mountain Plover (P)	R - all but MT 100 H - all but MT 100	MT 010, 020, 060, 064, 070, 090, 092	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Piping Plover (T)	R - MT 010, 020, 030, 040, 060, 064, 090, 092 H - MT 010, 020, 060, 064, 090, 092	MT 020	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Whooping Crane (E)	R - MT 010, 020, 030, 040,050,060, 064,090, 092 H - MT 010, 020, 050, 090, 092	MT 050	WF5, RH5, FT4, FT5, If presence of the species is documented the following guidance will apply: WF1, WF2, WF3, WF4, WF5, WF6, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Black-footed ferret (E)	R -MT 010, 020, 030, 040, 060, 064, 070,090, 092 H - MT 010, 020, 030, 040, 060, 064, 070, 090, 092	MT 040, 090	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Canada Lynx (T)	R - MT 010, 050, 060, 070, 100 H - MT 050, 060, 070, 100	MT 050, 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5, FT7

TABLE 9 (continued)
FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES AND SPECIES PROPOSED FOR LISTING

Species (Status) (E) Endangered (T) Threatened (P) Proposed	Field Offices/Stations In Range (R) and with Habitat Present (H)	Field Offices with documented occurrence	Guidance for fire suppression, rehabilitation, prescribed burning, and other fuel reduction efforts. See Appendix A.
Gray wolf (E)	R - MT 010, 050, 060, 064, 070, 100 H - MT 010, 050, 060, 064, 070, 100	MT 010, 050, 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5, FT7
Grizzly Bear (E)	R - MT 010, 050, 060, 070, 100 H – MT 010,050,060,070, 100	MT 050, 060, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5, FT7
Bull Trout (T)	R - MT 100 H - MT 100	MT 100	WF1, WF5, WF7, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Pallid Sturgeon (E)	R - MT 060, 064, 090, 092 H - MT 060, 064, 090, 092	MT 030, 040, 060, 064, 090, 092	WF1, WF5, WF7, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Ute Ladies'-tresses (T)	R - MT 050, 070, 100 H - MT 050, 070, 100	MT 050, 070	WF1, WF2, WF3, WF4, WF5, RH3, RH4, RH5, FT3, FT4, FT5
Water Howellia (T)	R - MT 100 H - MT 100	none	WF1, WF2, WF3, WF4, WF5, RH3, RH4, RH5, FT3, FT4, FT5
Western Prairie Fringed Orchid (T)	R - MT 040, 050 H - MT 040, 050	none	WF1, WF2, WF3, WF4, WF5, RH3, RH4, RH5, FT3, FT4, FT5

TABLE 10 BLM (MONTANA AND DAKOTAS) DESIGNATED SENSITIVE SPECIES			
Species	Field Offices In Range (R) and with Habitat Present (H)	Field Offices With Documented Occurrence	Guidance for fire suppression, rehabilitation, prescribed burning, and other fuel reduction efforts. See Appendix A.
BIRDS			
Bairds sparrow	R - MT 010, 020, 030, 040, 050, 060, 064, 070, 090, 092 H - 010, 020, 030, 040, 060, 064, 070, 090, 092	MT 010, 020, 030, 040, 060, 064, 090, 092, 100	WF1, WF2,WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Black-backed wood-pecker	R - MT 010, 020, 050, 060, 070, 100 H - same as above	MT 020, 050, 060, 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5, FT6
Black Tern	R - all Habitat - all	MT 020, 030, 040, 050, 060, 064, 090, 092	WF1, WF2, WF3, WF4, WF5, WF6, RH1, RH2, RH5, FT1, FT2,FT4,FT5
Boreal owl	R - MT 010, 050, 060, 070, 100 H - same as above	MT - 050, 060, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5, FT6
Burrowing owl	R - all H - all	all	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Canvasback duck	R - all H - all	all	
Columbian sharp-tailed grouse	R - MT 050, 070, 100 H - same as above	MT 050, 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Common loon	R - MT 020, 050, 060, 064, 070, 100 H - same as above	MT 020, 040, 050, 060, 064, 100	WF1, WF2, WF3, WF4, WF5 RH1, RH2, RH5, FT1, FT2, FT4, FT5
Dickcissel	R - MT 010, 020, 030, 040, 060, 064, 090, 092 H - same as above	MT 020, 040	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Ferruginous hawk	R - all H - all	all	WF1,WF2,WF3,WF4,WF5, RH1,RH2,RH5 FT1,FT2,FT4,FT5,FT6

TABLE 10 BLM (MONTANA AND DAKOTAS) DESIGNATED SENSITIVE SPECIES			
Species	Field Offices In Range (R) and with Habitat Present (H)	Field Offices With Documented Occurrence	Guidance for fire suppression, rehabilitation, prescribed burning, and other fuel reduction efforts. See Appendix A.
Flammulated owl	R - MT 010, 050, 060, 070, 100 H - same as above	MT 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5 FT1, FT2, FT4, FT5, FT6
Great gray owl	R - MT 010, 050, 060, 070, 100 H - same as above	MT 050, 060, 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5 FT1, FT2, FT4, FT5, FT6
Hairy woodpecker	R - all H - all	all	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5 FT1, FT2, FT4, FT5, FT6
Harlequin duck	R - MT 010, 050, 060, 070, 100 H -050,070,100	MT 050	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
LeConte's sparrow	R - 010, 020, 030, 040, 060, 064, 090, 092 H - same as above	MT 020	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4
Loggerhead shrike	R - all H - all	all	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5 FT1, FT2, FT4, FT5
Long billed curlew	R - all H - all	all	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Northern goshawk	R - all H - 010, 020, 040, 050, 060, 090,	MT 020, 040, 050, 064	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5, FT6
Peregrine falcon	R - all H - MT 010, 020, 050, 060, 064, 070, 100	MT 020, 010, 050, 060, 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5

TABLE 10 BLM (MONTANA AND DAKOTAS) DESIGNATED SENSITIVE SPECIES			
Species	Field Offices In Range (R) and with Habitat Present (H)	Field Offices With Documented Occurrence	Guidance for fire suppression, rehabilitation, prescribed burning, and other fuel reduction efforts. See Appendix A.
Pileated woodpecker	R - H -	MT 050	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5, FT6
Sage grouse	R - all H - all	MT 010, 020, 030, 040, 060, 075, 070, 090, 092	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Sage sparrow	R - MT 010, 020, 050, 060, 064, 070, 090, 092 H - same as above	MT 020, 050	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Swainson’s hawk	R - all H - all	all	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5 FT1, FT2, FT4, FT5, FT6
Three-toed woodpecker	R - MT 010 H - MT 010		WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5, FT6
Trumpeter swan	R - all H - all	MT 010, 020, 040, 050, 060, 064, 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5, FT6
White-faced ibis	R - all H - all	MT 020, 050, 060, 062, 092	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
MAMMALS			
Black-tailed prairie dog	R - MT 010, 020, 030, 040, 050, 060, 064, 070, 090, 092 H - same as above	MT 010, 020, 030, 040, 060, 064, 070, 090, 092	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Fisher	R - MT 010, 050, 060, 070, 100 H - same as above	MT 060, 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5

TABLE 10 BLM (MONTANA AND DAKOTAS) DESIGNATED SENSITIVE SPECIES			
Species	Field Offices In Range (R) and with Habitat Present (H)	Field Offices With Documented Occurrence	Guidance for fire suppression, rehabilitation, prescribed burning, and other fuel reduction efforts. See Appendix A.
Meadow jumping mouse	R - MT 010, 020, 030, 040, H - MT 010, 020, 030, 040, 060, 064, 090, 092	MT 010, 020,	
Merriam's shrew	R - all H - MT 010, 020, 030, 040, 064, 070, 090, 092	MT 010, 020, 060, 064,	
North American wolverine	R - 010, 050, 060, 064, 070, 100 H - same as above	MT 010, 050, 060, 064, 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Northern Bog Lemming	R - MT 050, 060, 070, 100 H - same as above	MT 050, 060, 100	
Preble's Shrew	R - all H - all	MT 010, 020, 060, 070,	
Pygmy rabbit	R - MT 050, 070, H - 050, 070,	MT 050	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Spotted bat	R - MT 010, 020, 050, H - MT 010, 020	MT 010	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Swift fox	R - MT 010, 020, 030, 040, 050, 060, 064, 070, 090, 092 H - same as above	MT 010, 020, 030, 040, 060, 064, 070, 090, 092	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Townsend's big-eared bat	R - all H - all	MT 010, 020, 040, 050, 060, 064, 070, 090,	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
Western spotted skunk	R - MT 010, 020, 040, 050, 070, 100 H - same as above	MT 010, 040, 050, 070, 100	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5
White-tailed prairie dog	R - MT 010 H - MT 010	MT 010	WF1, WF2, WF3, WF4, WF5, RH1, RH2, RH5, FT1, FT2, FT4, FT5

TABLE 10
BLM (MONTANA AND DAKOTAS) DESIGNATED SENSITIVE SPECIES

Species	Field Offices In Range (R) and with Habitat Present (H)	Field Offices With Documented Occurrence	Guidance for fire suppression, rehabilitation, prescribed burning, and other fuel reduction efforts. See Appendix A.
Woodland caribou	R - MT 100 H - MT 100	none	
REPTILES AND AMPHIBIANS			
Snapping turtle	R - all H - all	MT 010, 020, 040, 100	
Spiny softshell turtle	R - MT 010, 020, 050, 060, 064, 070, 090, 092, H - MT 010, 020	MT 010, 020, 060, 064,	
Canadian toad	R - 030, 060, 064, 090, 092 H - same as above	none	
Coeur d'Alene salamander	R - MT 050, 100 H - MT 050, 100	MT 050	
Spotted frog	R - MT 010, 050, 060, 064, 070, 100 H - same as above	MT 050	
Tailed frog	R - MT 050, 060, 064, 070, 090, 100 H - MT 050, 060, 070,	MT 050, 060, 070, 090, 100	
Wood frog	R - all H - all (except 050)	MT 040	
FISH			
Arctic grayling	R - MT 050, 070, 100 H - MT 050, 100	MT 050, 070	
Blue sucker	R– MT 090, 092 H– MT 090, 092	MT 020, 092	
Northern redbelly X Finescale dace	R–MT 092 H–MT 092	MT 020, 092	
Paddlefish	R - MT 010, 020, 030, 040, 064, 090, 092 H - MT 010, 020, 030, 040, 060, 064, 090, 092	MT 020, 040, 064, 090	
Pearl dace	R– MT 040 H– MT 040	MT 020, 040	

TABLE 10 BLM (MONTANA AND DAKOTAS) DESIGNATED SENSITIVE SPECIES			
Species	Field Offices In Range (R) and with Habitat Present (H)	Field Offices With Documented Occurrence	Guidance for fire suppression, rehabilitation, prescribed burning, and other fuel reduction efforts. See Appendix A.
Shortnose gar	R - MT 030, 040, 090, 092, H - same as above	MT 020, 092	
Sicklefin chub	R - MT 090, 092 H - MT 090, 092	MT 040, 090, 092	
Sturgeon chub	R - MT 020, 060, 064, 090,092 H - same as above	MT 020, 040, 092	
Westslope cutthroat trout	R - MT 050, 060, 070, 100 H - same as above	MT 050, 060, 070, 100	
Yellowstone cutthroat trout	R - 010, 020 H - 010, 020, 050	MT 010,050	

Cultural Resources

The effect of prescribed burning on cultural resources depends on the location of the resource with respect to the ground surface, the proximity to fuels that could provide a source of heat, the material from which artifacts are made, and the temperature to which artifacts are exposed. Threshold temperatures for damage to cultural artifacts manufactured from different materials, such as ceramic or stone, vary significantly.

Surface or near-surface cultural materials may be damaged, destroyed, or remain essentially unaffected by prescribed burning, depending on the temperatures reached and the duration of exposure to that temperature. Wooden structures or wooden parts of stone structures are susceptible to fire. Combustible artifacts lying directly on the ground surface could be damaged or destroyed. The ability to date noncombustible surface artifacts may be adversely affected if exposed to specific high temperatures. Subsurface materials are usually affected by fire only where significant amounts of soil heating occur (where dry accumulations of dead woody fuel or duff layers are consumed). Prescribed fires in areas of cultural significance would not be ignited under conditions dry enough to cause significant subsurface heating. Subsurface cultural resources are generally more subject to harm from construction of fire lines around planned fire boundaries than from the fire itself.

The heat, smoke, and soot from prescribed burning can also damage cultural resources, especially prehistoric rock art, by causing spalling which physically destroys the resource or by obscuring the surface of the resource with smoke and soot. Smoke and soot can damage cultural resources, by either increasing chemical deterioration or obscuring carvings and painted motifs.

Damage to cultural resources, prehistoric and historic, also results from fire suppression related activities. Often more damage is caused to cultural resources by blading fire lines, setting camps and staging areas, or using vehicles off road than by the fire.

Conclusion: Alternative B would provide more protection to cultural resources because more areas would be burned under controlled conditions where cultural inventories and mitigation would occur. This alternative also puts more restrictions on surface disturbance associated with fire suppression. See Appendix A. The acres of wildland fire and intensity of those fires would gradually decreased compared to Alternative A and cause less damage to cultural resources. This would also result in less accelerated soil loss and exposure and damage to cultural sites.

Recreational and Visual Resources

Large severe wildland fires often change the landscape in a way that degrades visual quality and recreation opportunities and recreation experiences, especially on forest lands where the duration of impacts is also longer. The use of heavy equipment to blade fire lines and the use of staging areas, often leaves lasting visual scars that also degrade the visual quality and recreation experience. During periods of high fire danger and extensive wildland fire activity, such as in the summer of 2000, large areas of public lands may also be closed to the use of open fires or to any recreation use to protect public safety.

Since smoke from fires degrades air quality and visual quality, they also degrade recreational experiences at developed recreation sites and dispersed recreation. Visitation to burned areas would decline or cease altogether in the short term. The time period until recovery depends on the severity of the fire. In the long term, however, visitation could increase if the fire creates more of the “edge effect”. The edge effect refers to the richness of flora and fauna occurring in a transition zone where two plant communities or successional stages meet and mix (USDA 1988).

Prescribed burning creates contrasting blackened areas and releases smoke into the air that temporarily impairs visibility. Burning does lessen the amount of logging debris that is seen and darkens the color of stumps and snags that, if not burned, would become more noticeable as they bleached over time. In the long term, prescribed burning might allow the regrowth of more aesthetically desirable vegetation.

Conclusion: Alternative B would provide more protection to cultural resources because there would be less intense and catastrophic wildland fires. This alternative also puts more restrictions on surface disturbance associated with fire suppression. See Appendix A. The acres of wildland fire and intensity of those fires would gradually decreased compared to Alternative A and cause less damage to visual quality and recreation resources.

Wilderness and Special Areas

Bear Trap Canyon (Lee Metcalf, 1983) is a 6,000 acre area included in the National Wilderness Preservation System. In addition, Montana BLM has 40 other areas totalling more than 452,500 acres that are Wilderness Study Areas (WSAs). All vegetation treatments in WSAs and designated wilderness areas would be conducted to avoid impairing the wilderness characteristics of the area. Actions in WSAs are guided by the Interim Management Policy (IMP) until Congress makes a final wilderness decision. The guidance contained in Appendix A summarizes the Interim Management Policy concerning fire.

The BLM manual states that prescribed burning may not be used solely as vegetation treatment in wilderness areas. Prescribed burning may be used to maintain fire-dependent natural ecosystems and to reduce the risk of wildland fires. Prescribed burning could be beneficial in some areas, such as ponderosa pine forests or shrublands, where fire exclusion has affected the ecosystem’s natural balance.

Conclusion: There would be very little difference of impacts on wilderness and wilderness values anticipated between the two alternatives. With Alternative B, there may be more of an awareness of the special considerations required for fire management of wilderness and WSAs.

Human Health and Safety

Smoke from fires will have a short-term impact on air quality. Individuals may experience eye, throat, or lung irritation from these exposures. People with asthma, allergies, and other breathing difficulties are likely to be especially sensitive to smoke from both wildland fires and from prescribed fires. Smoke would cause even greater breathing difficulty, eye irritations, sneezing, coughing, and other symptoms.

Possible effects on workers as a result of smoke exposure may include eye irritation, coughing, and shortness of breath.

Sociology

In 2000, the populations of Montana, North Dakota and South Dakota were each less than one million people, resulting in population densities of 6 people per square mile in Montana, 9 people per square mile in North Dakota and 10 people per square mile in South Dakota. Montana’s 2000 population of 902,195 was a 13 percent increase over 1990. During the same time period South Dakota’s population (754,844 in 2000) grew by nine percent and North Dakota’s population (642,200 in 2000) grew by less than one percent.

The movement of people into some rural areas began in the 1970s and is expected to continue into the 21st century. In scenic areas, particularly those suited for recreation, lands are being developed for recreation uses or subdivided for homes and cabins. New rural subdivisions are appearing across Montana and the Dakotas. In some cases, these subdivisions are adjacent to public lands. In 1999, BLM Field Offices completed a Wildland/Urban Interface Risk Questionnaire for areas adjacent to public lands. The results of the questionnaire indicate there are areas where medium to high potential for escaped fire, medium to high potential for loss of life or property and medium to high level of community support for dealing with fires.

The available attitude information on prescribed burns suffers from problems with definitions regarding the types of fires being assessed. The recently published "US Forest Service Communications Strategy: Prescribed Burning" summarizes the available attitudinal information this way: "...evidence exists suggesting the public and policy makers may not always understand or agree with the many issues surrounding prescribed burning. Direct and indirect research shows a pattern of growing public support of these policies; however, national surveys conducted since the Greater Yellowstone Ecosystem Fire of 1988 have demonstrated a lag between policy implementation and public acceptance.... In addition, public and policy maker support of prescribed burning is heavily influenced by issues relating to smoke and health; perceived degradation to ecosystem health; impacts of aesthetics, water and wildlife; and prescribed burns escaping control."

Since the Montana fires of 2000, additional attention and resources have been directed toward public attitudes regarding prescribed burns. Keeping appraised of and incorporating the evolving attitudinal information on prescribed burns can contribute to the success of these projects.

Conclusion: The movement of people into rural areas is expected to continue during the 21st century, which contributes to the emerging public opinion on prescribed burning on the public lands adjacent to rural/urban interface areas. Although not much attitudinal information is available on prescribed burns, there are some identifiable relationships between public opinion and the perceived image of prescribed burning. These issues include smoke impacts on health; the perceived effects of fire on the ecosystem; effects on aesthetics, water, and wildlife; and the possibility of prescribed burns escaping control and becoming wildfires. The public interest in hazardous fuels reduction generated by the fires of 2000 should contribute to an increased attention to public opinion regarding fires and prescribed burning, which will be useful in future projects and policies.

Relationship Between Short-term Uses and Long-term Productivity

Fire is a critical natural process that helps maintain healthy ecosystems and guards against natural disasters. While the total number of acres burned by wildland fire under either alternative may be essentially the same in the short term, eventually the severity of wildland fires will be reduced as Alternative B is implemented and hazardous fuels are reduced. Controlled fires on rangeland can promote seasonal growth of forage and a mosaic of wildlife habitats. Low-intensity fires in forest lands clear understory ladder fuels that could otherwise climb into tree tops and cause devastation. Prescribed fires conducted under specified conditions would eventually improve the health of the natural landscape and reduce the hazardous build-up of vegetation. Prescribed fires and other hazardous fuel reduction projects would help reduce the risk and devastation of raging wildland fire.

CONSULTATION AND COORDINATION

Public Notices, External and Internal Scoping

While BLM was trying to determine how best to approach a fire management update we consulted with other resource management agencies as well as our partners in fire suppressions efforts. We also conducted extensive internal scoping to determine how best to approach this. Contacts were identified at each Field Office and interdisciplinary team meetings were conducted at the Field Offices to identify preliminary issues and special areas of concern, to discuss appropriate methods of consultation and coordination, and to conduct preliminary discussions of alternatives and impacts. These efforts are summarized below.

Chronology of Consultation and Coordination Related to Fire Management Planning

<u>1998</u>

January	Bleiker process for public participation initiated in each District Office.
March 18	Letter sent to Northern Rockies Coordinating representatives explaining how we intended to approach fire management plan updates.
March 24	Follow-up conference call with Northern Rockies Coordinating representatives to